Tri-Basin Irrigator

Volume 17, Issue 4 July 6, 2017

Program Information

EQIP & Farm Program Benefits:

Ephemeral Gully Control Initiative

If you farm Highly Erodible Land that must follow a conservation plan to remain in compliance for USDA program benefits, then you need to keep reading.

In my first issue of this newsletter dated May 25, 2017, I mentioned that starting in 2017, ephemeral gully erosion is going to have to be controlled. These are the draws where runoff creates ditches that are disked in order to farm through them. See attached for more info.

This Ephemeral Gully Initiative is a program where you can receive financial assistance to help in controlling these erosive areas. Financial assistance will be provided for such things as cover crops, grassed waterways, terraces, erosion control structures, etc.

Application cutoff: July 21, 2017.

Last reminder via this newsletter.

Calendar of Events

July 18: TBNRD Board Meeting 1:30 PM – DATE CHANGE
July 17-20: Kearney County Fair
July 22-27: Phelps County Fair
July 27-29: Gosper County Fair
Aug 7: CNPPID Board of Directors Meeting 9 AM

Leaf Tissue Samples: PRIOR TO TASSEL!

Leaf tissue testing is an adaptive nitrogen management technique used to adjust nitrogen application rates in-season. It can diagnose crop growth problems and when coupled with soil tests, can be useful in refining nutrient inputs.

CSP Contract Holders

If you are a CSP contract holder with the "Water Quality Enhancement – WQL04 – Plant Tissue Tests and Analysis to Improve Nitrogen Management", then you will need to complete your leaf tissue tests now, prior to tassel.

Below is a brief outline of the procedure:

1. Appropriately collect multiple sub-samples at random from representative areas in the field that will be combined into a single sample for analysis.
2. Collect the youngest mature corn leaf prior to tassel from 15-20 plants for a sample.
3. Dirty samples need to be lightly rinsed to remove soil particles from the leaf. DO NOT over-rinse as soluble nutrients could be leached out.
4. Samples need to be air dried and placed in a paper bag for shipping.
5. Contact the lab for additional information on sampling and analysis.

Sign and turn in appropriate documents for CSP when done. If you have any questions, contact your local NRCS office.

Curtis's Column

USDA United States Department of Agriculture
Natural Resources Conservation Service

3-Year Pivot Irrigation Comparison:

This comparison is on two pivots on a ½ section farmed exactly the same. It's a no-till corn-soybean rotation on Holdrege Silt Loam soil. The only difference in the two pivots is how they are managed for irrigation. See table below.

This table shows a three year average on corn (2012, 2014, & 2016). Pivot B averaged 1.9 inches less water pumped per year while producing 1 extra bushel per year. Pivot B also averaged 0.3 inches more rain per year netting a water savings of 1.6 inches per year on the crop. Both started all years with a full soil water profile.

Two circles with a pivot per year can definitely save pumping costs, wear on equipment, and water for future generations. All while not losing bushels.

	Pivot A	Pivot B
Water Applied (Inches)	13.1	11.2
Yield (Bushels)	254	255

EQIP Dryland, No-till, & Grass Field Checks!!!

The NRCS will be starting their annual field checks for dryland, no-till, and grass contract obligations for EQIP contract holders. These checks will take place over the next month or so. This past spring, EQIP contract holders received a reminder letter with a map indicating which areas needed to be dryland, no-tilled, or have grass maintained. ***Failure to comply with your EQIP contract could result in termination, repayment of funds, and/or penalties.***

Soil Health Series: Soil Structure

Soil Structure is basically the arrangement of the solid soil parts and the pore spaces in between that make up the soil profile. Depending upon this arrangement, soil structure can benefit or hinder your operation.

A healthy structure will: support the microorganisms and earthworms in the soil which in turn allow for all the benefits of a healthy soil to happen, allow roots to move freely throughout finding additional moisture and nutrients, provide good water infiltration thus providing free water from rainfall to plants, reduce erosion due to increased soil aggregate strength and less runoff, and increase emergence due to reduced crusting.

Soil Structure declines with tillage. Tillage rearranges the solid soil parts and pore spaces. The result is: a destroyed environment for the microorganisms and earthworms, exposed organic matter to a greater rate of decay, compaction which affects water infiltration and root depth, increased erosion, and poor emergence.

Attached is a Soil Quality Indicator sheet for more info.

CNPPID Notes

75 years of Water Delivery:

The 75th year of Central water deliveries is underway. Yields from dryland crop production in Central's service area were a financial disaster before 1942, and then the water came. The fertile soil and climate was already here; only timely water was lacking.

As the first deliveries were made, 12-bushel corn turned into 120-bushel corn and now these same lands produce corn in the 250-bushel range. Second and third generations of the 1941 producers have financially sound operations from these same lands; through better crop genetics and pesticides but mainly by the availability of timely water. And, recharge to the aquifer from canal seepage has also brought prosperity to the adjacent landowners with groundwater wells.

The skill of the men who designed and built the system is impressive to this day. Water from Lake McConaughy moves through NPPD canals or the North Platte River to North Platte where it is diverted into Central's Supply Canal for hydropower production and irrigation. To gain hydraulic head, the Supply Canal falls 6 inches every mile as the Platte River falls 7ft. The canal runs close to the top of the Platte Basin divide in some locations so they gained nearly every foot of head they could get from the landscape. Their survey tools and machines seem rudimentary by today's standards but the engineers had everything they needed to get the job done well. The Central canals still flow by gravity from North Platte to NW of Minden, a distance of about 125 canal miles. And, hydropower keeps the regional lights on and groundwater pumps running.

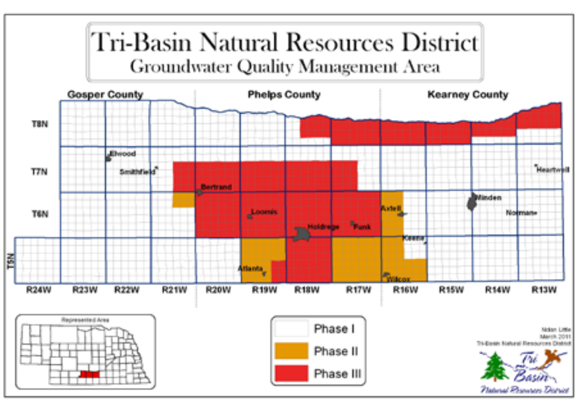
Sign up for a free tour of the Central system this summer; you will not be disappointed!

Tri-Basin NRD News

Remember to take water samples for Nitrogen Management Reports:

If you have fields in Phase 2 or Phase 3 of our Groundwater Quality Management Area (see map), you are required to sample your own irrigation water and test it for nitrates each year. With above average rains in some portions of the district causing a delayed start to the irrigation season, it's important to remember to collect the water samples once you start irrigating. If possible, you should take samples after the well has been running for a while, in order to get more accurate results.

The results from the samples you take this irrigation season will be used in nitrogen planning for next year's crop and reported on your 2018 Nitrogen Management Reports. Sample bottles are available at Tri-Basin NRD and the NRCS offices.



Nebraska Extension Extras

Western Bean Cutworms Emerging:

Now is the time to scout for western bean cutworm (WBC). These insects can cause severe injury to field corn, popcorn, sweet corn and dry beans. Julie Peterson, Nebraska Extension - West Center Entomologist, says that WBC treatment thresholds are generally based on when 25% of WBC moth flights are completed (2,577 degree-days); which our UNL Insect Computer Simulator predicts to occur on July 11th for our Holdrege area. *Note that hotter temperatures can move this date ahead 5 days.

Western Bean Cutworm moth eggs are laid on leaf whorls of corn, popcorn and sweet corn. Newly laid Western Bean Cutworm eggs look like small white beads (photo on left); while more mature eggs will have a purplish-white color prior to hatching. In pre-tassel corn, newly hatched larvae feed within the whorl on the flag leaf, flowers of the tassel and other yellow tissue.

Adult WBC moths (photo on right) are about ¾ inch long with a wing span of about ½ inch. Their body is light brown, and wings are generally dark brown. Further, their front wings have a broad white or cream stripe than runs two-thirds of the length of the leading edge. Behind this stripe is a central white spot with a half-moon shaped spot further away from the body.


Once the tassels begin emerging, the larvae will move to the leaf axils and green silks of the developing ears. Then, when pollen shed is complete and the tassels dry up, the larvae will move into the silks and later feed on the corn ear kernels. Larger larvae will feed primarily on kernels near the ear tip. Research has shown that one larva per plant at dent stage can reduce yield by 3.7 bushels per acre.

Scouting for WBC in corn can be much easier using Nebraska Extension's Speed Scouting *free mobile app* available at: http://cropwatch.unl.edu/begin-scouting-western-bean-cutworm-eggs-corn or downloadable Excel® (Western Bean Cutworm Speed Scouting Spreadsheet) EC1585. These scouting tools provide a method to collect data and indicate immediately whether treatment is warranted.

Japanese Beetles Emerging in Corn and Soybeans:

Adult Japanese Beetles may now be defoliating corn and soybeans in pocket locations within our region. Similar to Corn Rootworm Beetles, Japanese Beetles scrape off the green surface tissue on corn leaves prior to corn silks emerge; but prefer silks once they are available.

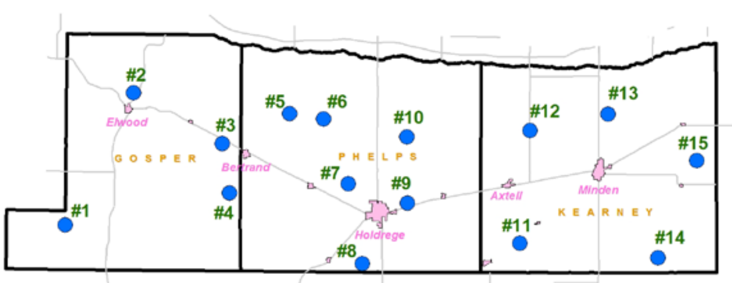
Usually, a key first indicator of possible Japanese Beetle population outbreaks is "rose defoliation" in home landscapes. Illinois Extension recommends insecticidal treatment during the corn silking period if there are: 1) three or more Japanese Beetles per ear; 2) silks have been clipped to less than ½"; and 3) pollination is less than 50% complete. Numbers are highest on field margins (borders).

NAWMN Crop ET Information

Additional Information and other ET resources can be found at websites listed under "ET Information Sites" below.

Inches of Crop Water Use (ET) = Evaporation x Kc

	June 19 – June 25		June 26 – July 2	
Site	Evaporation	Rain	Evaporation	Rain
1	2.10	0.30	1.90	2.10
2	2.10	0.27	1.90	0.50
3	1.70	0.30	1.70	0.18
4	2.40	0.38	1.30	0.13
5	2.00	0.00	1.80	0.30
6	1.80	0.15	1.60	0.15
7	2.00	0.09	1.80	0.33
8	2.20	0.46	1.70	0.70
9	2.00	0.00	1.60	0.10
10	2.10	0.00	1.80	0.45
11	2.00	0.80	1.80	0.46
12	1.80	0.00	1.50	0.24
13	2.10	0.38	1.80	0.47
14	1.90	0.00	1.70	0.85
15	2.20	0.00	1.70	0.89



2017 Map of NAWMN Sites across the Tri-Basin NRD.

Crop Coefficients (Kc)

Corn Stage	Kc	Soybeans Stage	Kc
2 leaf	0.10	Cotyledon (VC)	0.10
4 leaf	0.18	1st Node (V1)	0.20
6 leaf	0.35	2nd Node (V2)	0.40
8 leaf	0.51	3rd Node (V3)	0.60
10 leaf	0.69	Beg. Bloom (R1)	0.90
12 leaf	0.88	Full Bloom (R2)	1.00
14 leaf	1.01	Beg. Pod (R3)	1.10
16 leaf	1.10	Full Pod (R4)	1.10
Silk – Beg. Dent	1.10	Beg. Seed (R5)	1.10
¼ Milk Line	1.04	Full Seed (R6)	1.10
Full Dent (½ Milk)	0.98	Yellow Leaf (R6.5)	1.00
¾ Milk Line	0.79	Beg. Mat. (R7)	0.90
Black Layer	0.60	Full Mat. (R8)	0.20
Full Maturity	0.10	Mature	0.10

Crop Stage Information

Corn (V9-9 Leaf to V14-14 Leaf stage): Corn at the 12-leaf stage should be drawing moisture from 2 feet. The 15-leaf stage is the beginning of the most crucial period of plant development in terms of seed yield.

Avg. daily water use from June 26 – July 2 was 0.13"-0.27".

Soybeans (V6-Sixth Node to R1-Beginning Bloom stage): Soybeans at R1 should be drawing moisture from 2 feet. Vertical root growth increases sharply at R1. Secondary roots and root hairs proliferate after R1 in the top 9 inches.

Avg. daily water use from June 26 – July 2 was 0.16"-0.24".

June 26-July 2 (15 of 15 NAWMN sites reporting): Average weekly rainfall was 0.52 (range 2.10 to 0.10). Average weekly ET for corn was 1.38 and for soybeans was 1.41.

ET Information Sites

NAWMN Sites:

- *http://www.cnppid.com/news-info/weatheret-data/nebraska-agricultural-water-management-network/*
- *https://nawmn.unl.edu/ETdata/DataMap*

CropWatch: *http://cropwatch.unl.edu/gdd-etdata*
CNPPID: *http://www.cnppid.com/news-info/weatheret-data/*
Water Use Hotline: 1-800-993-2507

Corn Stage		***DESCRIPTION***
V14	14 Leaves	Leaf stage is defined by number of leaves with visible collars. The collar is a discolored line where the leaf meets the stalk. This line circles the stalk. NOTE: Some bottom leaves are lost due to plant development. The leaf stage will be higher than the actual leaves you count by roughly 2-4 leaves.
V16	16 Leaves	
R1	Silking	Begins when any silks are visible outside the husks.

Soybean Stage		***DESCRIPTION***
R1	Beg. Bloom	At least one open flower is present at any main stem node.
R2	Full Bloom	At least one open flower is present at any one of the two uppermost main stem nodes that have fully developed leaves.

Lake and River Levels

CNPPID Reservoir Elevation and Platte River Flow data listed below and other locations can be found on CNPPID's website at http://cnppid.com/wp-content/uploads/2016/06/lakeRiverData.html.

	July 6, 2017, 8:00 AM	1 Year Ago
Capacity of Lake McConaughy	85.3%	NA
Inflows to Lake McConaughy	NA cfs	3537 cfs
Flows on the North Platte at North Platte	NA cfs	1060 cfs
Flows on the South Platte at North Platte	NA cfs	621 cfs
Flows on the Platte at Overton	NA cfs	2130 cfs

The will to succeed is important, but what's more important is the will to prepare.

- Bobby Knight

Websites of Interest

Soil Health: www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/

Climate	agclimatenebraska.weebly.com
SAM Registration	www.sam.gov
NRCS Nebraska	www.ne.nrcs.usda.gov
Central Irrigation District	www.cnppid.com
TBNRD Home Page	www.tribasinnrd.org/
Farm Service Agency	www.fsa.usda.gov
UNL Cropwatch	cropwatch.unl.edu
UNL Extension	extensionpubs.unl.edu/
K-State SDI Website	www.ksre.ksu.edu/sdi
No-till On The Plains	www.notill.org

Rainfall

Rainfall amounts listed below and other locations come from NeRAIN which can be found at website https://nednr.nebraska.gov/NeRain/Maps/maps.

Location:	June 22 – July 5	May 1 – July 5
Arapahoe 6.9 NW:	0.73	6.15
Bertrand 6.1 mi. SE:	0.52	6.49
Funk 4.1 mi. NNE:	0.32	7.29
Minden 0.855 mi. W:	0.46	9.93
Minden 8.8 mi. ESE:	1.34	8.86

Average Rain for May-June in Holdrege = 8.04 Inches

****** If you wish to receive this newsletter via e-mail, or have any questions, comments or ideas, feel free to contact Curtis Scheele at the NRCS office in Holdrege or you can email him at curtis.scheele@ne.usda.gov. ******

USDA - Natural Resources Conservation Service

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PO Box 798
Holdrege, NE 68949-0798
308-995-6121, Ext. 3

309 Smith Street
PO Box 41
Elwood, NE 68937-0041
308-785-3307, Ext. 3

1005 South Brown Street
Minden, NE 68959-2601
308-832-1895, Ext. 3

Central Nebraska Public Power & Irrigation District

415 Lincoln Street
PO Box 740
Holdrege, NE 68949
308-995-8601

Tri-Basin Natural Resources District

1723 Burlington Street
Holdrege, NE 68949
308-955-6688

Nebraska Extension

1308 2nd Street
Holdrege, NE 68949
308-995-4222

PO Box 146
Elwood, NE 68937
308-785-2390

424 North Colorado
PO Box 31
Minden, NE 68959
308-832-0645

Controlling Ephemeral Gully Erosion on Highly Erodible Land.

Nebraska Agronomy Technical Note NE-111

NRCS Natural Resources Conservation Service

February 2012

What is Ephemeral Erosion?

Simply defined ephemeral means seasonal or temporary. Ephemeral gully erosion is so named because it tends to occur at the same point on the landscape year after year and is obliterated by annual tillage operations only to re-occur following subsequent rainfall events. Ephemeral gully erosion can also occur in fields where no-till is being practiced due to large drainage areas, excessive slopes, poor crop production resulting in low residue levels and/or poor soil quality. Ephemeral gully erosion characteristics and prediction methods are described in the Field Office Technical Guide (FOTG) Section I, Subsection D-2 Water Erosion.

The Highly Erodible Land Conservation Compliance (HELC) provisions of the Food Security Act of 1985, as amended, require that ephemeral gully erosion be controlled on all highly erodible land used for the production of a commodity crop (NFSAM Sec. 512.0 C).

Typical Ephemeral Gully

Concentrated Flow areas

Concentrated flow areas may require treatment to control gully erosion. This is especially true if they have been de-vegetated due to land shaping or farming operations, or if the existing vegetation or residue cover is not adequate to prevent gullying. In all cases where concentrated flow areas are present, it is advisable during the conservation planning process to conduct a field visit in order to determine actual site conditions including channel slope, cross-section (channel capacity) and drainage area in order to complete the erosion analysis using either the Ephemeral Gully Erosion Prediction Worksheet or the Ephemeral Gully Erosion Look-up Tables which are found in Section IV of the FOTG. Small capacity channels (less than 20 ft top width at one foot of flow depth) are especially vulnerable to gully erosion. Results from the Look-up Tables indicate that gully erosion is likely if drainage areas are greater than 2-5 acres in size using conventional or mulch tillage. Implementing a high residue, continuous no-till system will increase the drainage area tolerance to 8-12 acres depending on your location in the state.

If field measurements are not available, the maximum allowable drainage area based on an average of residue and tillage management systems for steep, small capacity channels are:

- Eastern NE: 5 acres
- Central NE 5 acres
- Western NE 7 acres

For any ephemeral channel with drainage area exceeding these values, one or more treatment options to control ephemeral gully erosion must be included in the conservation plan.

Treatment Options

There are several treatment options for controlling ephemeral gully erosion ranging from implementing a continuous no-till system to structural practices such as terraces and waterways. The practices are listed on the back of Nebraska Conservation Planning Sheet 18 and include:

- Cover crops
- Grass Waterways
- Water & Sediment Control Basins
- Terraces
- Diversions
- Contour Buffer Strips

Concentrated flow area treated with a fall seeded cover crop.

Cover Crops

The preferred cover crop for both concentrated flow areas and critical overland flow areas requiring treatment is fall-seeded cereal rye. Annual ryegrass has also been used, but some varieties have proven to be glyphosate resistant. . Small grain should be seeded at a rate of 1 bu/ac drilled or 2 bu/ac broadcast no later than September 15 in Vegetative Zones I & II and October 15 in Vegetative Zones III & IV (Refer to the Nebraska Vegetative Zones Map located in Section I of the FOTG). If spring cover seeding is required, oats may be used at the same rate and should be planted as soon as possible following the earthwork, but generally not earlier than March 15.

Cover crops may be chemically destroyed (glyphosate) when they have produced adequate growth to stabilize critical areas (6 -8 inches is minimal; 12+ inches is optimal). In some cases, it will be necessary to apply the chemical after the spring crop has been planted. Appropriate crop varieties need to be selected to allow for this scenario.

Cover crops are strongly encouraged as part of any crop rotation containing low or fragile residue producing crops such as soybeans to provide additional stability to concentrated flow areas and prevent the necessity of damage repair or maintenance.

Channel Shaping

Channel shaping to produce a broad, shallow flow condition will reduce the potential for ephemeral erosion.
Care should be taken during channel shaping operations to retain as much top soil as possible and to minimize fill placement in concentrated flow areas as un-compacted fill will tend to be unstable. Retaining native perennial vegetation or establishing and maintaining grassed waterways in concentrated flow areas is preferable to cropping them for the sake of channel stability; when de-vegetation of concentrated flow areas is necessary, as for channel shaping, a close seeded small grain cover crop should be seeded immediately following earthwork activity. Mulching would be another option.

Maintenance

Annual inspection and maintenance of concentrated flow areas is important.

Where erosion has occurred to the extent that it will hinder planting of the next crop, maintenance should be completed immediately after harvest. This should be done with minimal tillage operations no deeper than the erosion which has occurred and no wider than necessary to make planting possible followed immediately by drilling a cover crop (as described above).

Use of a blade with rubber-tire compaction to shape eroded areas is the preferred method to accomplish repair of damage.

If erosion damage is occurring even as the result of normal rainfall events of 2 – 4 inches, additional conservation treatment is required in order to satisfy the HELC requirements.

Planning Documentation

Planning documentation should include the following:

☐ RUSLE2 documentation of soil loss, STIR and SCI

☐ Conservation plan map with critical areas identified

☐ Conservation plan and/or Planning Sheet 18

☐ Results of ephemeral gully analysis

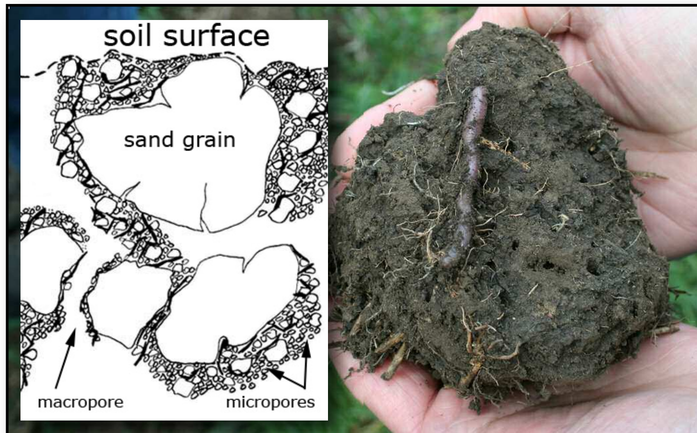
☐ Design and installation requirements for structural practices

☐ Practice operation and maintenance requirements

Soil Structure & Macropores

Sand, silt and clay particles are the primary mineral building blocks of soil. Soil structure is the combination or arrangement of primary soil particles into aggregates. Using aggregate size, shape and distinctness as the basis for classes, types and grades, respectively, soil structure describes the manner in which soil particles are aggregated. Soil structure affects water and air movement through soil, greatly influencing soil's ability to sustain life and perform other vital soil functions.

Soil pores exist between and within aggregates and are occupied by water and air. Macropores are large soil pores, usually between aggregates, that are generally greater than 0.08 mm in diameter. Macropores drain freely by gravity and allow easy movement of water and air. They provide habitat for soil organisms and plant roots can grow into them. With diameters less than 0.08 mm, micropores are small soil pores usually found within structural aggregates. Suction is required to remove water from micropores.



High residue and cover crops contribute organic matter to soil, while no-till management helps protect organic matter and allow accumulation. Organic matter provides food for earthworms and other soil biota. All play a role in developing or protecting soil structure and macropores to help soil function at a high level. Inset shows relationship of macro- and micropores to soil aggregates.

Factors Affecting

Inherent - Aggregation of soil particles to develop soil structure is affected by clay particles and shrinking and swelling of clay masses. Clay particles carry a negative charge on their surface that can cause them to repel each other, but that attracts and adsorbs cations present in the soil. Stacks of clay particles can form when their negative surface charge is neutralized by tightly adsorbed polyvalent cations, such as Ca^{2+} and Al^{3+}. Further, Ca^{2+}, Fe^{2+} and Al^{3+} flocculate (clump together) stacks of clay particles, and with humus (negatively charged, highly decomposed, stable organic matter), bind to form small, stable soil aggregates.

In contrast, sodium ions (Na^{+}) are associated with soil dispersion. They are monovalent, relatively large and they are the prominent cation adsorbed to clay particles in some soils in arid and semi-arid regions. Because of their relatively weak charge and large size, sodium ions are ineffective at promoting clay stacking and aggregate formation. Dispersed clay causes the soil to be almost structureless, impervious to water and air, and undesirable for plant growth.

When soil dries out and water is removed, clay stacks move closer together, the soil shrinks in volume, and cracks develop in weakly bonded areas. As soil wetting and drying cycles are repeated with rainfall (or irrigation) and removal by plants, an extensive network of cracks develops and soil aggregates become more defined. Freezing and thawing cycles have a similar shrinking and swelling effect since freezing of soil water to form ice crystals withdraws water from clay structures. Shrinking and swelling breaks apart and compresses soil particles into defined structural aggregates. Certain types of clay particles have shrink-swell properties of their own.

Dynamic - While chemical and physical factors play a prominent role in small aggregate formation in clay soils, biological processes are important for development of large aggregates and macropores, and they are the primary factor for aggregation of sandy soils. Important biological processes include: earthworms burrowing in soil and ingesting soil particles to form casts, development of sticky networks of roots and fungal hyphae, and production of organic glues by fungi and bacteria. Plant roots also contribute to aggregation and development of macropores as they push through the soil while they are growing or by leaving channels when they die. Mycorrhizae, or thread-like fungi, secrete a gooey protein called glomalin that is an effective cementing agent for providing short-term stability of large aggregates. Organic glues are produced by fungi and bacteria as they decompose plant residues. Water-resistant substances produced by roots and microorganisms provide long-term stability of months to a few years of soil aggregates.

Organic matter is the major contributing factor for aggregate formation that can be directly affected by human management. It provides energy for microbial processes that release organic products. The organic products chemically interact with soil particles and iron and aluminum oxides to bind soil particles together into aggregates. Tillage can have favorable and unfavorable effects on aggregation and soil structure. Short-term, tillage breaks clods apart, incorporates organic matter into the soil, and loosens it to increase porosity; however, long-term, tillage increases decomposition of organic matter, prevents accumulation, and reduces its aggregating effects. Tillage of wet soil generally destroys surface soil structure.

Relationship to Soil Function

Important soil functions related to soil structure are: sustaining biological productivity, regulating and partitioning water and solute flow, and cycling and storing nutrients. Soil structure and macropores are vital to each of these functions based on their influence on water and air exchange, plant root exploration and habitat for soil organisms. Granular structure is typically associated with surface soils, particularly those with high organic matter. Granular structure is characterized by loosely packed, crumbly soil aggregates and an interconnected network of macropores that allow rapid infiltration and promote biological productivity. Structure and pore space of subsurface layers affects drainage, aeration, and root penetration. Platy structure is often indicative of compaction.

Problems with Poor Function

Clay soils with poor structure and reduced infiltration may experience runoff, erosion, and surface crusting. On-site impacts include erosion-induced nutrient and soil loss and poor germination and seedling emergence due to crusted soil. Off-site impacts include reduced quality of receiving waters due to turbidity, sedimentation and nutrient enrichment. Water entry into a sandy soil can be rapid, but subsurface drainage of sandy soils with poor structure can also be rapid such that the soil cannot hold water needed for plant growth or biological habitat.

Practices that lead to poor soil structure include:

- Disturbance that exposes soil to the adverse effects of higher than normal soil drying, raindrop and rill erosion, and wind erosion
- Conventional tillage and soil disturbance that accelerates organic matter decomposition
- Residue harvest, burning or other removal methods that prevent accumulation of soil organic matter
- Overgrazing that weakens range and forage plants and leads to declining root systems, poor growth and bare soil
- Equipment or livestock traffic on wet soils
- Production and irrigation methods that lead to salt or sodium accumulation in surface soils

Crumbly structure of surface soil is associated with adequate organic matter content.

Improving Soil Structure & Macropores

Practices that provide soil cover, protect or result in accumulation of organic matter, maintain healthy plants, and avoid compaction improve soil structure and increase macropores.

Practices resulting in improved soil structure and greater occurrence of macropores favorable to soil function include:

- Cover Crop
- Conservation Crop Rotation
- Irrigation Water Management
- Prescribed Grazing
- Residue and Tillage Management
- Salinity and Sodic Soil Management

Evaluating Soil Structure & Macropores

Schoeneberger, PJ, Wysocki, DA, Benham, EC, and Broderson, WD (editors). 2002. Field Book for Describing and Sampling Soils, Version 2.0. Natural Resources Conservation Service, National Soil Survey Center, Lincoln, NE.

Soil structure is described in the Soil Quality Test Kit Guide, Section I, Chapter 11, pp. 23 – 27. See Section II, Chapter 10, p. 76 for interpretation of observations.

Reference: Brady, NC and Weil, RR. 2002. The Nature and Properties of Soils, 13th Edition. Prentice Hall, NJ.

Time needed: 60 minutes