Crop Science Investigation Workshop Series Lesson Plans

Subject: Soil Quality Lessons **Grade Level(s):** 7th – 12th grades
Lesson Title: What are factors should be considered when planting corn or soybeans?
Time period: 2, 2 hour sessions (depending on activities conducted)

These lessons can be adapted for youth of any age depending on level of technical content taught. When working with youth of varying ages, it is suggested to have older youth help the younger ones.

Learning objectives

1. Conduct in-field assessment of soil pH.
2. Conduct in-field assessment of soil electrical conductivity
3. Conduct in-field assessment of soil compaction or layers restrictive to root growth
4. Conduct in-field assessment of water infiltration
5. Conduct in-field assessment of soil aggregate stability

Materials and Supplies: pH test paper; EC meter; brazing rod or another rod of ≤1/4" diameter; infiltration rings; tea strainers and cups for holding the water; water source.

Background Information:

Soil pH is important to nutrient availability and plant health and is often to problems constraining crop yield. It can be easily measured in the field using pH test papers or pocket meters; accuracy is typically within 0.3 unit of lab measurement. The test can be done with 1:1 water:soil slurries or even by pressing damp soil against the test strip.

Soil electrical conductivity is a measure of salts in solution. High salt (saline) or high sodium (sodic) soils are not common in Nebraska but do occur. Salinity can be associated with excessive manure application, especially slurry manures from dairy or swine operations. Concentrated manure effluent from feeding operations can be sufficiently high in salts to cause crop damage when applied through sprinkler irrigation to a growing crop. Irrigation water can be salty, e.g. if pumped from the Dakota sandstone aquifer. EC can be easily tested in a 1:1 water:soil slurry or other liquid or slurry using a pocket EC meter.

Soil compaction occurs more frequently that many realize and can restrict root growth. Soil compaction can be easily determined by probing moist soil with a brazing rod or another rod; assuming moist soil, a ¼" rod should penetrate medium texture soils easily. Shallow compaction can be corrected with tillage or it can be corrected with freeze-thaw and wet-dry cycles with enough time. More important, compaction often indicates a management problem.

Water infiltration rate is largely determined by soil type but also by management. Water infiltration rate is easily assessed using infiltration rings. Add the equivalent of one inch of water and determine the time for infiltration. Add a second inch of water and determine its infiltration time which will generally be shorter than for the first.

The **stability of soil aggregates** in water is important for soil resistance to crusting, the splash effect of raindrops, and of other types of erosion. Put 1 tbs of soil in a tea strainer and dip the strainer into a cup of water 50 times. Dump the wet soil on a table and observe the extent to which the soil stands up as well as the amount of soil in the water: 1) Soils with water stable aggregates with maintain structure and have relatively clean water compared with a weak structure soil; 2) soils with weak stability slump and the water has a heavy soil load.

Resources:

Wortmann, C. and P. Jasa, 2009. Management to minimize and reduce soil compaction. NebGuide G89-896, University of Nebraska.

Wortmann, C., M. Mamo, and C. Shapiro. 2003. Management strategies to reduce the rate of soil acidification. NebGuide G03-1505, University of Nebraska.

Wortmann, C.S and S.C. Brubaker, 2004. Soil aggregation: a practical exercise for crop producer education. J. Extension 42(6) *http://www.joe.org/joe/2004december/tt7.shtml*).

Source:

Charles Wortmann
Southeast Research and Extension Center
58C Filley Hall
Lincoln NE 68583
(402) 472-2909

Cwortmann2@unl.edu

(High School Level Lesson)

Lesson: Nitrogen management for corn

Learning objective: Achieve high nitrogen use efficiency with little loss to the environment.

Materials and Supplies. N rate slide rule.

Nitrogen is an essential nutrient for plant growth and much is applied to soil for corn production. There are several environmental concerns associated with fertilizer nitrogen use. Fossil fuel use and CO2, a greenhouse gas, emission are associated with N fertilizer production and transport. Nitrogen application can result in N losses by: 1) leaching to groundwater or sub-surface drainage, including with tile drainage, to surface water; 2) runoff loss to surface waters with water pollution effects, possibly accompanied by increased algal growth and hypoxia; 3) ammonia volatilization with deposition in N-sensitive eco-systems, e.g. Rocky Mountain National Park; 4) and nitrous oxide (N2O), another green house gas, emission. These concerns increase with increased application. Greatest profitability is achieved with the economically optimal N rate (EONR); increases above EONR contribute to environmental impact with no compensating benefit. Application at less than EONR results in some loss of profit but can have substantial environmental benefit, especially in cases of high risk of N loss. Much research has been conducted to more accurately estimate EONR.

Estimation of EONR considers several factors.

1. EONR is increased if expected corn yield increases.
2. EONR is decreased if soil organic matter increases.
3. EONR is decreased if residual soil nitrate in the 0-4' soil depth increases.
4. EONR is decreased if nitrate-N is applied in irrigation water.
5. EONR is decreased if the previous crop was soybean or drybean compared with corn or another cereal.
6. EONR is decreased if manure or another N source was well-applied.
7. EONR is decreased if fertilizer N price is high relative to grain price with increased or decreased rates if the value of one bushel of corn is greater or less than 8 lb of fertilizer N.
8. EONR is decreased if much of the N is applied in-season rather than all in the fall or early spring.
    - The UNL equation for estimating EONR is: N Rate (lb/acre) = 35 + (1.2 x EY) – (8 x NO_3-N) – (0.14 x EY x OM).

Exercise 1. Use N rate slide rule to determine EONR if: expected yield is 225 bu/ac; soil organic matter is 2.5%; mean soil nitrate-N level is 5 ppm; the previous crop was soybean; 7 lb N can be purchased for the value of one bushel of grain; and 40% of the N is applied in the spring pre-plant and 60% is applied in-season. No manure is applied and nitrate-N in irrigation water is very low.

Exercise 2. Use on-line soil test software to determine EONR for the above.

Resources:

Shapiro, C.S., R.B. Ferguson, G.W. Hergert, C.S. Wortmann, and D.Walters. 2009. Fertilizer suggestions for corn. University of Nebraska EC 117.

On-line soil test software (soiltest.unl.edu).