United States Department of Agriculture
Natural Resources Conservation Service

Water Quality Enhancement Activity – WQL08 –Apply Split Applications of Nitrogen Based on a Pre-Sidedress Nitrogen Test on Cropland

Enhancement Description

The use of a Pre-Sidedress Nitrogen Test (PSNT) to determine the need and/or rate of additional nitrogen to be applied during a sidedress application.

Land Use Applicability

This enhancement is applicable on corn grown on cropland.

Benefits

Sidedress applications of ammonia-N based on a PSNT may lower the total amount of ammonia fertilizers applied, therefore controlling the conversion of ammonia to nitrate and ultimately to nitrogen gas through nitric oxide (an ozone precursor) and nitrous oxide (a greenhouse gas). Nitrate, while taken up by plants as a nutrient, is also unstable in soil and can move with water through the soil into surface and ground water. Also, the above conversion processes produce nitrous oxide as a byproduct. Nitrous oxide is a potent greenhouse gas which has 310 times the global warming potential of carbon dioxide on a molecular basis. Using split applications of ammonia-N based on a PSNT will help to reduce nitrate contamination of surface and ground water, and reduce an enterprise's nitrous oxide emissions, improving its overall greenhouse gas footprint.

The PSNT is primarily used to test if side-dress N fertilizer is needed on fields with a history of manure application. PSNT attempts to:

- Gauge the pool of potentially mineralizable organic N in the soil, and
- Link that pool with a likelihood of a yield response from additional N fertilizer at side-dressing time.

Criteria for Applying Split Applications of Nitrogen Based on a Pre-Sidedress Nitrogen Test on Crop Land

Where to use the PSNT:

- Corn fields, 2 years or more after a sod where the manure rate or mineralization rate is uncertain.
- Where calculations indicate that the full complement of manure was not applied to meet the expected N needs of the crop.
- Cases where N mineralization rates are expected to be higher than average.

- When there is uncertainty as to whether enough manure was actually applied to meet expected corn crop N requirements.

Where not to use the PSNT:

- Corn fields that had pre-plant / early post-plant broadcast fertilizer N applications (other than <40 lbs starter N/acre in the band).
- Corn fields that are first year corn after modest amount of alfalfa with grass. No yield response is expected from side-dress N, therefore there is no need to conduct PSNT.

Additional Criteria:

1. Producer must currently apply ammonia-based nitrogen fertilizer as part of the cropping system.
2. Producer must have a current soil test (no more than 5 years old).
3. Producer must have a Pre Side-dress Nitrogen Test (PSNT)
4. Nutrient application rates are within the "Land Grant University" recommendations based on soil tests and established yield goals considering all nutrient sources.
5. For full implementation of this enhancement, the producer shall apply crop nutrients using two or more separate applications during each cropping season in a rotation following the recommendations of the PSNT for all annual corn crops. If the PSNT indicates that no additional nitrogen fertilizer is needed, no additional nitrogen shall be applied.
6. Soil surface disturbance shall be minimized.

Documentation Requirements for Applying Split Applications of Nitrogen Based on a Pre-Sidedress Nitrogen Test on crop land

1. Written documentation for each year of this enhancement describing the following items:
   - Recommendations from the PSNT
   - Dates of application of nutrient applications to provide evidence of split applications
   - Type(s) of nutrients (fertilizer and organic) applied
   - Treatment area(s)
   - Soil test results
   - Crops grown and yields (both yield goals and measured yield)
   - Calibration of application equipment

2. A map showing where the enhancement is applied.

WATER QUALITY ENHANCEMENT ACTIVITY

WQL08–OR Split Applications of Nitrogen Based on the Pre-Sidedress Nitrogen Test (PSNT) on Cropland Planted to Corn

Using PSNT in Oregon

Early spring soil tests are not an indicator of N available during the growing season and are not an effective tool to make decisions about mid season fertilizer application. Testing for soil nitrate-nitrogen during the growing season, after some N has become plant available, but before the crop's greatest need for nitrogen, is the best indicator of the need for additional nitrogen. The test is called the Pre-Sidedress Nitrogen Test (PSNT). The PSNT sample is taken between the rows to a 12" depth, and is done when the corn has five collared leaves or is about 12 inches tall. Collect the sample according to *Directions for PSNT* on the following pages. Send the sample o a soil testing lab to be analyzed for nitrate-nitrogen (NO3-N). Request the results in parts-per-million (ppm) or milligrams/kilogram (mg/kg), not pounds/acre (lbs/ac). Interpret the results according to Table 9 on the following pages. Keep a written record of all nutrient applications (see Documenting the Enhancement #5). Calibration of application equipment is required with this Enhancement. Directions for calibrating manure spreaders and irrigation equipment are included at the back of this supplement.

A list of laboratories serving Oregon can be found at:
http://extension.oregonstate.edu/catalog/html/em/em8677/

Guidance on taking and interpreting the PSNT for corn is taken from Oregon State University Extension publication EM8978-E, *Silage Corn Nutrient Management Guide-Western Oregon*, available at:
http://extension.oregonstate.edu/catalog/pdf/em/em8978-e.pdf

Documenting the Enhancement

1. **Attach a map or aerial photo showing fields where the Enhancement is applied.**
2. **Enhancement Fields/Acres:**

Field(s)	Acres

Documenting the Enhancement (Continued)

3. PSNT Soil Test Results (attach copy of test):

____> 25 ppm ____<25 ppm

4. Nutrient Application Decision Based on PSNT:

____No additional nitrogen applied as PSNT levels are adequate

____Additional nitrogen applied (circle appropriate N application rate category):

PSNT Value (ppm)	Apply this amount of N (lbs/ac)
0-10	100-175
11-20	50-100
21-25	0-50
>25	0

Actual N Application Rate:___________

5. Is the actual nitrogen application rate within these OSU guidelines?
_____Yes ____No

6. Nutrient Application Records By Treatment Area

Fertilizer Applications

Date	Field	Total (Gross) Applied (lbs./acre)	Formulation (%N-P_2O_5-K_2O)	Net Applied (lbs./acre) N	P_2O_5	K_2O

7. Yields
Expected:___________ bushels/acre Measured:____________ bushels/acre

8. Was application equipment calibrated?
___Yes ___No

Information from:

Silage Corn Production in Western Oregon: Nutrient Management Guide, Oregon State University Extension Service

View the entire document online at: http://extension.oregonstate.edu/catalog/

Nitrogen management

Starter N applications

Most fields with a history of manure application require no starter N fertilizer. If 3 years have passed since the last manure application, or the field has not regularly received manure, apply no more than 40 lb/a N as a banded starter fertilizer. Starter N can be supplied by manure or commercial fertilizer.

Understanding corn growth and N uptake

Early-season N uptake by corn is minimal, as corn grows slowly for the first 30 days, or until it has five or six leaves. After 10 leaves are produced, growth is rapid, with new leaves appearing every 2 or 3 days.

Early-season N uptake exceeds dry matter accumulation. A small amount of N (20 to 40 lb/a) is accumulated before the plant has 10 leaves. N uptake is rapid between the 10-leaf stage and silk emergence (end of July), when approximately 90 lb/a (almost 3 lb/a/day) is used by the crop. At silk emergence (Figure 8), approximately two-thirds of total seasonal accumulation of N is already in the crop, but less than half the dry matter has been accumulated (Figure 9).

Figure 8.—Corn showing silk emergence. One-third of seasonal N uptake occurs after silk emergence.

Nitrogen monitoring options

The following tests can be used to confirm the adequacy of N supply. On fields receiving frequent manure application, both early-season and postharvest tests can be used as planning tools for future years. The early-season pre-sidedress soil nitrate test (PSNT) test can also be used to adjust the current-season sidedress N fertilizer rate.

Early season

- **PSNT**. Used to evaluate N supply status of the field and make sidedress N rate recommendations. If the PSNT is above 25 ppm N, sidedress N fertilization is not needed. PSNT is often positively correlated with postharvest N values (see page 10).

Postharvest

- **Stalk nitrate test** (page 10). The adequate range is 3,500 to 5,500 ppm N (dry weight basis).
- **Silage crude protein** (CP; page 11). CP is adequate when silage protein is above 6.5 percent or silage N is above 1 percent (dry weight basis).
- **Postharvest nitrate test** (PHNT; page 11). Used after harvest to evaluate N application management. An end-of-season value below 20 ppm N indicates that the silage corn crop utilized most of the plant-available N in the soil.

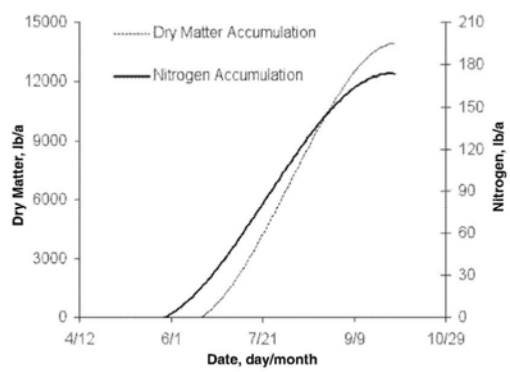


Figure 9.—Silage corn aboveground biomass (dry matter) and nitrogen accumulation. The graph is a compilation of silage corn N uptake information from California, Oregon, and New Jersey since 1984. One-third of seasonal N uptake is assumed to occur after silk emergence, which occurs at the end of July or when 1,000 growing degree-days have been accumulated.

Growing season N application

Because early-season N uptake by corn is minimal, wait until corn has five or six leaves before applying N. Use plant development (not the calendar) to determine when to apply N. Adequate N supply is extremely important for silage corn between the 10-leaf stage and the time silk appears. Therefore, N should be applied—if needed—shortly after the corn has five or six leaves.

Soil tests performed in early spring do not tell how much N will be available during the growing season, and so these tests cannot be used to make midseason fertilizer decisions. Most soil N is held in organic matter and is unavailable to plants. As the soil warms, increased biological activity converts organic N to plant-available N. To accurately predict the need for midseason N application, the N that becomes available early in the growing season should be measured.

In western Oregon, testing soil for nitrate-N when silage corn has five or six leaves is an excellent indicator of the need for additional N. This test is called the pre-sidedress soil nitrate test (PSNT). It measures soil nitrate-N (NO_3-N) during the growing season, after some N has become plant-available but before the crop's time of greatest need. The test will accurately predict how much plant-available N will be released from spring-applied manure or spring-incorporated cover crop. The PSNT can also be used, however, to determine N application rates on unmanured fields.

To perform the PSNT, measure nitrate-N between the rows to a depth of 12 inches when corn has five or six leaves (approximately 12 inches high at the center of the whorl). See sidebar at right for sampling instructions.

If midseason PSNT values are greater than 25 ppm, more than enough N probably will be available. If the PSNT is below 25 ppm, N is **not** sufficient to produce economically optimum silage corn. Approximate N fertilizer rates required to meet crop N need at PSNT values less than 25 ppm are shown in Table 9.

Manure testing

Manure nutrient content varies with amount and type of bedding, feed source, handling, and addition of materials such as footbath solutions. Test manure periodically to determine nutrient supply for crops. See *Which Test Is Best? Customizing Dairy Manure Nutrient Testing* (PNW 505) and *Fertilizing with Manure* (PNW 533).

Directions for PSNT

Sample soil when the corn has five collared leaves or at least a week before planned sidedressing (Figure 10). This usually coincides with a plant height of about 12 inches at the center of the whorl.

- Collect the soil sample between rows, away from fertilizer bands. Avoid irregular areas, such as low areas or places where manure accumulates.
- Collect a composite sample of 15 to 20 cores. The more cores you collect, the better your chance of getting an accurate measurement.
- Sample soil to a depth of 12 inches.
- Mix the sample thoroughly in a clean container. Fill a soil sample bag with a subsample of the mixed soil.
- Send the sample to a soil testing lab to be analyzed for nitrate-N (NO_3-N).The sample should be delivered to the lab immediately. To avoid shipping delays over the weekend, do not mail samples on Thursday or Friday. Changes in N occur when the soil is warmed.
- Request results in ppm or mg/kg, **not** lb/a.

If soil nitrate-N is above 25 ppm, no additional nitrogen is needed. If soil nitrate-N is below 25 ppm, apply N at the rate shown in Table 9.

Figure 10.—A pre-sidedress soil nitrate test (PSNT) should be taken when corn has six leaves with collars or is about 12 inches tall.

Table 9.—Nitrogen rate recommendations for western Oregon using the PSNT.*

PSNT value NO_3-N (ppm)	Apply this amount of N (lb/a)	Amount of manure to apply: If manure supplies 4 lb N/1,000 gal (gal/a)	(acre-inches)	If manure supplies 6 lb N/1,000 gal (gal/a)	(acre-inches)
0–10	100–175	25,000–44,000	1.0–1.5	17,000–30,000	0.6–1.1
11–20	50–100	12,500–25,000	0.5–1.0	8,000–17,000	0.3–0.6
21–25	0–50	0–12,500	0–0.5	0–8,000	0–0.3
Above 25	0	0	0	0	0

*Use as a guide. To refine N rates for your cropping system, monitor yield, silage crude protein, and stalk nitrate-N, or use a postharvest soil nitrate test (see pages 10–12).

Spreader Calibration
(Using Bucket, Pan or Tarp)

Name:____ Date:__________

Operator:______________________________________ Spreader ID:__________

Perform the following operations to calibrate the solids spreader

- ✓ **Place buckets, pans, or tarps in the application area to collect the applied or spread waste material.**
- ✓ **Spread waste material over the application area using the spreading pattern normally used in the field. Make sure the spreader is traveling at the speed it typically travels over the collection area. Record engine rpm and gear settings used.**
- ✓ **Collect and weigh the waste material and calculate the average application rate. Use this worksheet to record the weights and calculations.**

Note: Use Tarps instead of buckets or pans when using dry stack manure or separated solids as the variability in the weight will be less.

Data and Calculations:

Steps	ID of Bucket, Pan or Tarp					
	A	B	C	D	E	F
1. Date of calibration test-						
2. Engine RPM during spreading -						
3. Gear selected during spreading -						
4. Weight of empty bucket (lb) =						
5. Weight of bucket with waste (lb) =						
6. Weight of Waste (lb) - line 5 – line 4 =						
7. Collection Area (sq ft) - Area of the top of the bucket, pan or tarp used to collect the waste =						
8. Waste Applied (lb/sq ft) - line 6 ÷ line 7 =						
9. Covert to tons per acre - line 8 x 21.78 =						
10. Average Application Rate (tons per acre)- Sum of values in cells A9 through F9 divided by the total number of calibrations completed =						

Additional Notes:

Spreader Calibration
(Using a Full Spreader Load)

Name:____ Date:___________

Operator:_______________________________________ Spreader ID:___________

Perform the following operations to calibrate the solids spreader equipment:
✓ Determine the weight of the waste material loaded in the spreader by using truck scales to weigh the spreader equipment when it is empty and full.
✓ Spread the loaded spreader on the field using consistent speed and spreader settings to cover the field uniformly. Spread in a rectangular pattern so the area calculation will be simple. Record engine rpm and gear settings used.
✓ Measure the length and width covered by the full load and compute the application rate in tons per acre using this worksheet.
Data and Calculations:

Steps	ID of Calibration Test					
	A	B	C	D	E	F
1. Date of calibration test-						
2. Engine RPM during spreading -						
3. Gear selected during spreading -						
4. Weight of empty spreader (lb) =						
5. Weight of loaded spreader (lb) =						
6. Weight of Waste in spreader (lb) - line 5 – line 4 =						
7. Length of spreading area (ft) =						
8. Width of spreading area (ft) =						
9. Area spread (sq ft) - line 7 x line 8 =						
10. Waste applied (lb/sq ft) – line 6 ÷ line 9=						
11. Convert to tons per acre - Line 10 x 21.78=						
12. Average Application Rate (tons per acre) – Sum of values in cells A11 through F11 divided by the total number of calibrations completed =						

Additional Notes:

Tank Equipment Calibration
(Using a Full Tank Load)

Name:____ Date:___________

Operator:____ Spreader ID:___________

Perform the following operations to calibrate the tank equipment:

- ✓ **Determine the maximum capacity of the tank equipment from the manufacturer's maintenance manual or the owners manual for the equipment.**
- ✓ **Fill the tank and reduce the volume of the tank by the appropriate amount if the tank is not filled to its maximum capacity. Normally a tank spreader is only filled to about 80 percent of its maximum capacity and therefore the maximum rated capacity of the tank should be multiplied by 0.8 to reflect the volume of the loaded tank during the calibration exercise.**
- ✓ **Spread the loaded tank on the field using consistent speed and settings to cover the field uniformly. Try to spread in a rectangular pattern so the area calculation will be simple. Record engine rpm and gear settings used.**

Data and Calculations:

Steps	ID of Calibration Test					
	A	B	C	D	E	F
1. Date of calibration test-						
2. Engine RPM during spreading-						
3. Gear selected during spreading-						
4. Maximum rated capacity of tank (gallons) =						
5. Volume of filled tank (gallons)- Line 4 x ____ % of tank filled ÷ 100% =						
6. Length of spreading area (ft) =						
7. Width of spreading area (ft) =						
8. Area spread (sq ft)- line 6 x line 7 =						
9. Waste applied (gal/sq ft)- line 5 ÷ line 8 =						
10. Convert to gallons per acre - Line 9 x 43,560 =						
11. Average Application Rate (gallons per acre) – Sum of values in cells A10 through F10 divided by the total number of calibrations completed =						

Additional Notes:

Traveling Big Gun Sprinkler Calibration
(Using Catch Cans)

Name:____ Date:___________

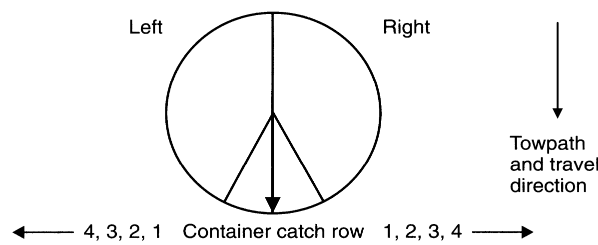
Perform the following operations to calibrate the traveling big gun sprinkler:

- ✓ **Use 5 to 10 catch cans to collect the sprinkler-irrigated waste. Use straight-sided buckets for catch cans. Two pound coffee cans work well. Make sure all of the catch cans have the same diameter.**
- ✓ **Place one of the catch cans on a level surface and fill it with water to a known depth (1-3 inches). Pour the water from the catch can into a large measuring cup. Determine how many measuring cups of water are equal to an inch of water in the catch can.**
- ✓ **Place at least five catch cans across the towpath of the big gun sprinkler. Try to space the catch cans uniformly from the center of the towpath to the outer edge of the wetted area of the sprinkler. Stake the catch can in place or put a rock in the bottom of the catch can to keep it upright. Allow the traveling big gun sprinkler to completely pass over the catch cans. Use the measuring cup previously used to calibrate the catch cans to measure the amount of liquid collected in each can and convert the volume to inches. Be sure to add together the amount measured from the catch cans that would receive overlap from the adjacent towpath. For example, if catch can #4 will receive liquids from the adjacent towpaths, add the amount from container #4 on the left to container #4 on the right side to compute the total amount applied at the location of container #4 on the right and left sides of the towpath.**

Catch Can Calibration:

Example: 1 inch = 5 Cups
1 cup = 0.2 Inches

Your Catch Cans: 1 inch = ________ Cups
1 cup = ________ Inches



Travel Rate Setting During Test:

Data and Calculations:

Catch Can ID	**Volume of Liquid**							
	Cups	**Inches**	**Cups**	**Inches**	**Cups**	**Inches**	**Cups**	**Inches**
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								
Average =								