Water Quality Enhancement Activity – WQL11 – Precision application technology to apply nutrients

Enhancement Description
The use of precision agriculture technologies to apply nutrients to fit variations in site-specific conditions found within fields**.**

Land Use Applicability
Cropland and pastureland.

Benefits
Precision agriculture methods are used to collect information needed to more precisely evaluate production input factors, accurately predict crop yields, and precisely apply variable rates of nutrients. The primary benefit of precision agriculture techniques is the use of accurate information about within field variability to minimize nutrient losses and optimize inputs. Done properly this helps to protect surface and ground water resources while maximizing net production.

Criteria

Implementation of this enhancement requires the use of nutrient management techniques. This enhancement requires:

1. The use of the following precision agriculture practices:
    a. Variable rate technologies (VRT) for nutrient application- Computer-controlled equipment that adjusts fertilizer applications based on soil maps, vegetative indexes, or yield maps, etc. used to create management zones. Nitrogen, phosphorus and potassium fertilizer will be applied according to Land Grant University recommendations in the management zones.
    b. Yield monitoring systems - Yields in the field are measured using combine-mounted sensors or volume meters. A GPS receiver mounted on the combine is required to correlate field location with yield to create a yield map.
2. Soil samples for nutrient analysis are taken based on soil management zones or on a maximum of a five acre grid
3. Base nitrogen application rates on a real time analysis of crop nitrogen needs. Examples include in season aerial photography and in field equipment based chlorophyll sensors.
4. Producer must have current soil tests for P and K (and Nitrogen where applicable) that are no more than 3 years old

5. Nutrient application rates must be within the "Land Grant University (LGU) recommendations based on soil testing and established yield goals and considering all nutrient sources.

Documentation Requirements

Documentation for each Treatment area (field) and year of this enhancement describing these items:

1. A map showing where the activities are applied.
2. Treatment acres
3. Crop grown in each treatment area
4. Soil sampling protocol (grid or zone) for each treatment area
5. Number of soil samples taken per treatment area
6. Soil test results
7. Calibration of fertilizer application equipment
8. Nutrient application rates/amounts and application dates for each treatment area
9. When using NDVI, provide an as-applied digital map of nutrients applied

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Reference: 590 – Nutrient Management

Total nutrient application rates shall be consistent with University of Minnesota or contiguous land grant university recommendations.
http://www.extension.umn.edu/CommodityCrops/

http://www.extension.umn.edu/distribution/cropsystems/DC5886.html

Use of this enhancement in Minnesota may or may not result in net income increases or N loss reductions.

This enhancement requires 1) fertilizer application equipment that changes rates on the fly across a field and 2) a combine mounted GPS receiver to record yields to correlate with field location and to create yield maps.

- Phosphorus and potassium applications are variable rate applied based on zone management to include grids if grid sampling is performed.
- Nitrogen applications are variable rate applied in-season[1] based on real time analysis of crop nitrogen needs using algorithms or indices[2]. Examples include:
  - Land-based equipment mounted optical sensors[3] such as Green Seeker® and Crop Circle® to compare health and/or chlorophyll status of highly fertilized plants to plants in the rest of a management zone.
  - Satellite imagery and/or aerial ortho-photo interpretations[4] to create or refine management zones for future applications.

[1] In-season N application windows in Minnesota are limited especially in dryland farming by the time notable differences between reference strips and the rest of the field are consistently observed.

[2] Algorithms or indices used to determine the amount of N to apply in-season are not readily available from the University of Minnesota and if available from other land grant institutions may not be applicable to the growing conditions in this state. http://www.nue.okstate.edu/

[3]Most Minnesota research on use of land-based optical sensors for in-season N management has been conducted on corn.

[4]Using satellite imagery to help determine in-season variable N rates is problematic and use of aerial ortho-photography to determine in-season variable N rates seems unrealistic.