PennState Extension

Cover Crop and Soil Organic Matter Nitrogen Credit Worksheet

Field/Zone:					
1. Determine Humification Coefficient (ε)					
1a. Clay Content (%)					
1b. Sand Content (%)					
1c. Calculate **ε** $\varepsilon = 0.52 + 0.0036 \times \%Clay - 0.0097 \times \%Sand$					
2. Determine Soil Organic Matter (SOM) Credit (ΔY_{SOM})					
2a. Zone SOM Average (%SOM)					
2b. Calculate ΔY_{SOM} $\Delta Y_{SOM} = 154 \times \%SOM \times (1 - \varepsilon)$					
3. Determine Cover Crop Credit (ΔY_{cc})					
3a. Nitrogen in Cover Crop Biomass, lbs N/ac (N_{CC}) (can be obtained from Greenseeker NDVI)					
3b. Carbon to Nitrogen (C:N) Ratio $(C:N)_{cc}$					
3c. Select α (α=0.55 when cover crops are N mineralizing and α=1.8 when N immobilizing) Cover crops will be immobilizing when $C:N_{cc}>(10/e)$					
3d. Calculate ΔY_{cc} $\Delta Y_{cc} = \alpha \times N_{cc} \times \left(1 - \frac{\varepsilon \times (C:N)_{cc}}{10}\right)$					
4. Calculate Unfertilized Corn Yield (Y_{UF})					
4a. Calculate Y_{UF} : If $(\Delta Y_{SOM} + \Delta Y_{cc}) > 532$ then $Y_T = 215$, else $Y_{UF} = (\Delta Y_{SOM} + \Delta Y_{cc}) - 0.00094\,(\Delta Y_{SOM} + \Delta Y_{cc})^2 - 51$					
5. Determine N Fertilizer Requirement					
5a. Corn Yield Target, bu/ac (Y_{TAR})					
5b. Calculate Yield Gap (Y_G) Yield Gap = $Y_{TAR} - Y_{UF}$					
5c. Calculate N Fertilizer Efficiency (N_{eff}) based on Yield Gap $If\ YG > 110\ bu/ac, then\ N_{eff} = 1.0$ $Else,\quad Neff = 0.008 \times Y_G + 0.12$					
5c. Calculate Fertilizer N Recommendation (lbs/ac) $N_{Fertilizer} = Y_G \times 1.2/N_{eff}$					

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Calculation Instructions and Background Information

1. Determine Humification Coefficient (ε) Background: This value represents the proportion of carbon that will remain in microbial biomass and soil organic matter within the time period of corn N uptake.
1a. Enter clay content in %. This value would come from a soil texture analysis of the field or zone.
1b. Enter sand content in %. This value would come from a soil texture analysis of the field or zone.
1c. Use sand and clay content in the equation to calculate a value for ε. This value will be used in later steps.
2. Determine Soil Organic Matter (SOM) Credit (ΔY_{SOM}) Background: This step will determine the component of the yield credit derived from mineralization of soil organic matter.
2a. Enter the soil organic matter level in %. This value would come from a soil test.
2b. Use soil organic matter level and the previously calculated value ε in the equation to calculate the soil organic matter yield credit.
3. Determine Cover Crop Credit (ΔY_{cc}) Background: This step will determine the component of the yield credit derived from mineralization of cover crop residues. This credit may be positive or negative, depending on whether the cover crop mineralizes or immobilizes N. If there is no cover crop in the field, skip immediately to step 3d and place a zero in this row.
3a. Enter the aboveground biomass N content of the cover crop in lbs N/acre. This can be measured from a hand-harvested quadrat of biomass that is dried, weighed, and analyzed for %N. Or it can be estimated from the NDVI measured by a handheld Greenseeker.
3b. Enter the carbon to nitrogen (C:N) ratio of the aboveground cover crop biomass. This is measured on a grab sample of cover crop tissue from the field or zone. If you just measure %N, you can assume %C = 44% to estimate the C:N ratio.
3c. In this row, select a value to use for α, which is a coefficient that converts the quantity of mineralized N into a corn grain yield credit. The value depends on whether cover crops are going to mineralize N or immobilize N. To determine the mineralizing or immobilizing status, calculate the critical threshold for immobilization, which is 10/ε, using the value for ε calculated on line 1c. If the cover crop C:N ratio entered in line 3b is below the critical C:N ratio, then the cover crop is mineralizing and use α=0.55. If the cover crop C:N ratio entered in line 3b is greater than the critical C:N ratio, then the cover crop is immobilizing and use α=1.8.
3d. Use the cover crop N content from line 3a (N_{cc}), the cover crop C:N ratio from line 3b ($C{:}N_{cc}$), α from line 3c and ε from line 1c in the equation to calculate the yield credit from the cover crop (ΔY_{cc}).
4. Calculate Unfertilized Corn Yield (Y_{UF}) Background: This step will add together the yield credits from soil organic matter and cover crop residues. Because the yield response to N mineralization has diminishing returns, a squared term in the equation is needed.
4a. Add together the yield credit from SOM (line 2b) and the yield credit from cover crops (line 3d). If this sum is greater than 532, the unfertilized corn yield is 215 bu/ac. Otherwise, enter the sum of the SOM and cover crop credits into the quadratic equation to determine the unfertilized corn yield.
5. Determine N Fertilizer Recommendation Background: The N fertilizer recommendation is based on the yield gap between an unfertilized corn yield (calculated in line 4a) and the yield target for a site (determined from previous experience). This yield gap is multiplied by the physiological N uptake requirement for corn, which is 1.2 lbs N/bushel, and divided by the N fertilizer efficiency. From previous analysis of yield response curves, we can predict the N fertilizer efficiency based on the size of the yield gap.
5a. Enter the corn yield target for the site or zone based on previous experience.
5b. The yield gap (Y_G) is the difference between the target yield (line 5a) and the unfertilized corn yield (line 4a).
5c. The N fertilizer efficiency is based on the yield gap (line 5b). If the yield gap is more than 110 bu/ac, then use a value of 1.0. Otherwise, calculate the fertilizer efficiency by entering the yield gap into the equation.
5c. Calculate the N fertilizer recommendation in lbs N/ac by entering the yield gap (line 5b) and the fertilizer efficiency (line 5c) into the equation.