NW CROPS & SOILS PROGRAM

2016 Corn Cropping Systems to Improve Economic and Environmental Health

Dr. Heather Darby, UVM Extension Agronomist
Nate Brigham, Julija Cubins, Abha Gupta, and Sara Ziegler
UVM Extension Crops and Soils Technicians
802-524-6501

Visit us on the web at: http://www.uvm.edu/extension/cropsoil

UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

2016 CORN CROPPING SYSTEMS TO IMPROVE ECONOMIC AND ENVIRONMENTAL HEALTH

Dr. Heather Darby, University of Vermont Extension
heather.darby[at]uvm.edu

In 2016, UVM Extension's Northwest Crops & Soils Program continued a multi-year trial at Borderview0 community. Soil proteins (N mg/soil g) are measured with citrate buffer extract, then autoclaved.   This measurement is used to quantify organically bound nitrogen that microbial activity can mineralize from soil organic matter and make plant-available. Soil respiration (CO_2 mg/soil g) is measured by amount of CO_2 released over a 4 day incubation period and is used to quantify metabolic activity of the soil microbial community.

The corn variety was Mycogen's TMF2Q419, which has a relative maturity (RM) of 96 days. The NC, and Forage analyzer. Dried and coarsely-ground plot samples were brought to the UVM's Cereal Grain Testing Laboratory where they were reground using a cyclone sample mill (1mm screen) from the UDY Corporation. The samples were then analyzed using the FOSS NIRS DS2500 for crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), 48-hour digestible NDF (NDFD), total digestible nutrients (TDN), and Net Energy-Lactation (NE_L).

Perennial forage first cut biomass samples were harvested by hand with clippers in an area of 12' x 3' section in fescue treatments on 31-May, second cut biomass samples were cut using the same procedure on 19-Jul, and third cut biomass samples were cut using the same procedure on 7-Sep. Perennial forage moisture and dry matter yield were calculated and yields adjusted to 35% dry matter. An approximate 2 lb subsample of the harvested material was collected, dried, ground, and then analyzed at the University of Vermont's Cereal Grain Testing Laboratory, Burlington, VT, for quality analysis.

Mixtures of true proteins, composed of amino acids and non-protein nitrogen, make up the CP content of forages. The CP content of forages is determined by measuring the amount of nitrogen and multiplying by 6.25. The bulky characteristics of forage come from fiber. Forage feeding values are negatively associated with fiber since the less digestible portions of plants are contained in the fiber fraction. The detergent fiber analysis system separates forages into two parts: cell contents, which include sugars, starches, proteins, non-protein nitrogen, fats and other highly digestible compounds; and the less digestible components found in the fiber fraction. The total fiber content of forage is contained in the neutral detergent fiber (NDF). Chemically, this fraction includes cellulose, hemicellulose, and lignin. Because of these chemical components and their association with the bulkiness of feeds, NDF is closely related to feed intake and rumen fill in cows. In recent years, the need to determine rates of digestion in the rumen of the cow has led to the development of NDFD. This in vitro digestibility calculation is very important when looking at how fast feed is being digested and passed through the cow's rumen. Higher rates of digestion lead to higher dry matter intakes and higher milk production levels. Similar types of feeds can have varying NDFD values based on growing conditions and a variety of other factors. In this research, the NDFD calculations are based on 48-hour in vitro testing.

Net energy for lactation (NE_L) is calculated based on concentrations of NDF and ADF. NE_L can be used as a tool to determine the quality of a ration, but should not be considered the sole indicator of the quality of a feed, as NE_L

Yield data and stand characteristics were analyzed using mixed model analysis using the mixed procedure of SAS (SAS Institute, 1999). Replications within trials were treated as random effects, and hybrids were treated as fixed. Hybrid mean comparisons were made using the Least Significant Difference (LSD) procedure when the F-test was considered significant ($p<0.10$).

Variations in yield and quality can occur because of variations in genetics, soil, weather, and other growing conditions. Statistical analysis makes it possible to determine whether a difference among hybrids is real or whether it might have occurred due to other variations in the field. At the bottom of each table a LSD value is presented for each variable (i.e. yield). Least Significant Differences (LSDs) at the 0.10 level of significance are shown. Where the difference between two hybrids within a column is equal to or greater than the LSD value at the bottom of the column, you can be sure that for 9 out of 10 times, there is a real difference between the two hybrids. Hybrids that were not significantly lower in performance than the highest hybrid in a particular column are indicated with an asterisk. In the following example, hybrid C is significantly different from hybrid A but not from hybrid B. The difference between C and B is equal to 1.5, which is less than the LSD value of8(l)65q S

Table 3

On 17-Jun, soil samples were collected for PSNT analysis (Table 6). The mean soil nitrate-N (NO^{-3}) among the treatments was 8.06 ppm. The NT treatment had significantly lower soil nitrate-N and higher N amendment recommendation than the other cropping systems. Nitrogen, in the form of urea, was applied to the corn treatments based on their respective PSNT results.

Table 6. Soil nitrate-N and N recommendations for medium and high yield potential, Alburgh, VT, 2016.

* Treatments with an asterisk did not perform significantly lower than the top-performing treatment which is shown in **bold**.

Corn Silage Results

On 16-Sep, data was collected on corn silage populations and plots were harvested to determine moisture and yield (Table 7). Corn populations ranged from a low of 29,403 plants per acre (WCCC) to a high of 32,706 plants per acre (CC). The WCCC treatment had significantly lower populations than the other treatments. Yields (adjusted to 35% dry matter basis) ranged from 23.1 to 28.1 tons per acre. The WCCC treatment had the highest yield, with the NT treatment being significantly lower than the others. (Figure 1).

Pest and disease scouting occurred on 3-Jun (data not shown). Pest were scouted at harvest but no pest damage was identified. No foliar diseases were identified. Pests identified included corn borers, cut worms, and corn maggots. The CC treatment had the highest number of pests per plot (an average of 2.50 pests per plot). The other treatments had similar pest populations (an average of 2.0 pests per plot for the NC treatment, and an average of 1pests per plot for the WCCC and NT treatments).

Table 7. Corn silage population, harvest dry matter and yield by treatment, Alburgh, VT, 2016.

Figure 1. Dry matter yields of corn cropping systems in tons per acre, Alburgh, VT, 2016. Treatments that share a letter were not significantly different from one another (p=0.10).

Standard components of corn silage quality were analyzed (Table 8). There were a few significant differences in quality between cropping systems. The NT treatment had the highest crude protein, significantly more than any other treatment. The NT treatment also had significantly lower milk production in terms of milk per acre than the rest of the treatments.

Table 9. Impact of harvest date on perennial forage quality, 2016.

Alfalfa/Fescue cutting	CP % of DM	ADF % of DM	NDF % of DM	NDFD % of NDF	Yield at 35 DM t ac^{-1}
1st cut 31-May	15.3	33.2	64.4	57.2	8.47
2nd cut 19-Jul	22.0	30.3	58.2	60.2	8.55
3rd cut 7-Sep	19.2	32.3	59.0	58.5	6.96
Trial mean	18.8	32.0	60.5	58.6	7.99

Multi-year comparison

Figures 2-5 compare yields and soil health characteristics over the past two years of the trial. Overall, yields were relatively the

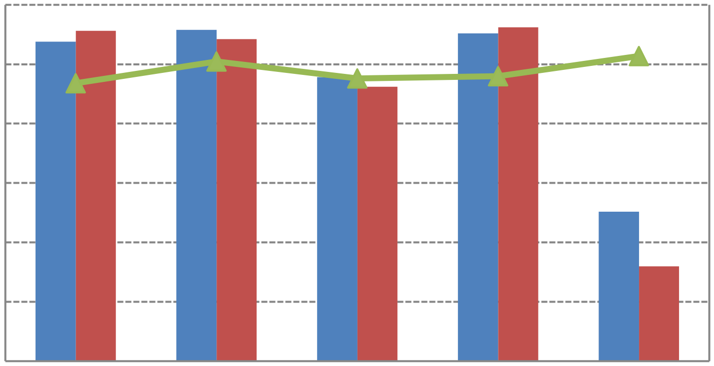

Figure 3. Comparison of cropping systems yields and soil active carbon in 2015 and 2016, Alburgh, VT.

Figure 4. Comparison of cropping systems yields and soil protein in 2015 and 2016, Alburgh, VT.

Figure 5. Comparison of cropping systems yields and soil respiration in 2015 and 2016, Alburgh, VT.

DISCUSSION

The goal of this project is to monitor soil and crop health in these cropping systems over a five year period. Based on the analysis of the data, some conclusions can be made about the results of this year's trials. In terms of soil quality, PF systems performed best overall,