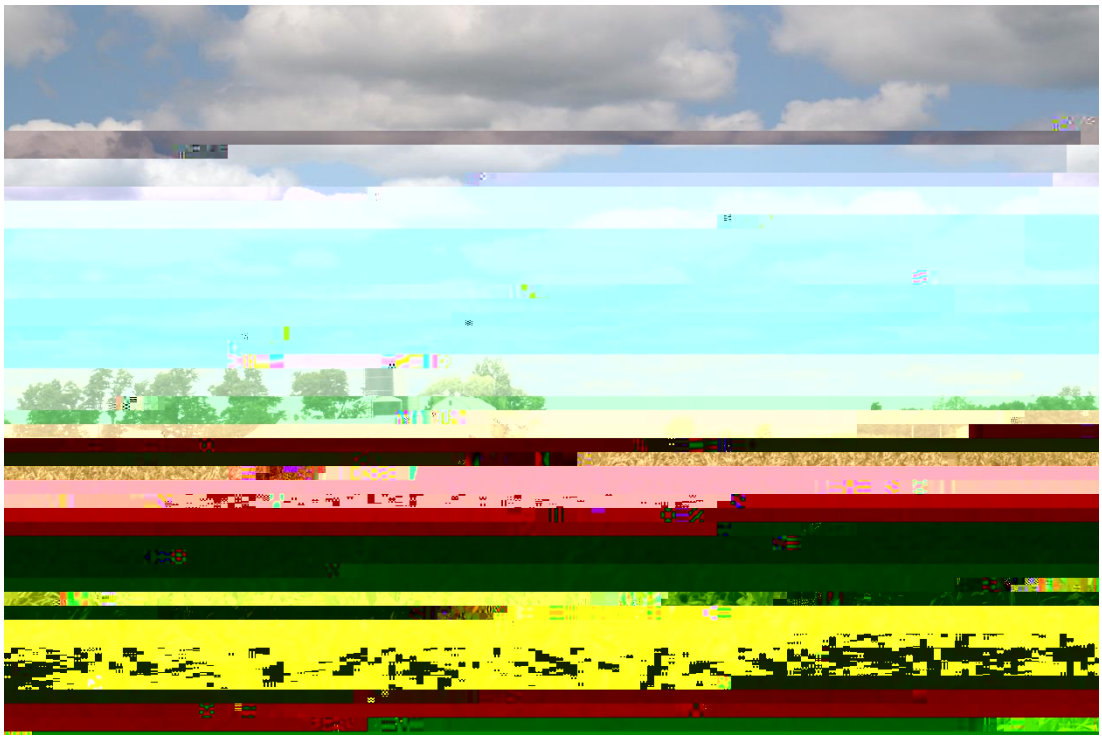
NORTHWEST CROPS & SOILS PROGRAM

2021 Corn Cropping Systems to Improve Economic and Environmental Health



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THE UNIVERSITY OF VERMONT EXTENSION

2021 CORN CROPPING SYSTEMS TO IMPROVE ECONOMIC AND ENVIRONMENTAL HEALTH

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In 2021 continued a multi-year trial at Borderview Research Farm in Alburgh, VT to assess the impact of corn cropping systems on overall health and productivity of the crop and soil. Management choices involving crop rotation, tillage, nutrient

Percent aggregate stability was measured by Cornell Sprinkle Infiltrometer and indicates ability of soil to resist erosion. Predicted percent available water capacity and predicted soil protein (N mg/soil g) was calculated with a Random Forest model from a suite of measured parameters and soil texture (Cornell Soil Health Manual Series, Fact Sheet Number 19-05b). Predicted soil protein is used to quantify organically bound nitrogen (N) that microbial activity can mineralize from soil organic matter and make plant-available. Percent organic matter was measured by loss on ignition when soils are dried at 105 to remove water then ashed for two hours at 500 . Total carbon (organic and inorganic forms) is measured using complete oxidation of carbon at high temperature combustion (2000° F). Total nitrogen is measured with DUMAS combustion methodology. It measured organic (living and non-living) and inorganic (mineral) forms of nitrogen. Active carbon (active C mg/soil kg) was measured with potassium permanganate and is used as an indicator of available carbon (i.e. food source) for the microbial community. Soil respiration (CO_2 mg/soil g) is measured by amount of CO_2 released over a four-day incubation period and is used to quantify metabolic activity of the soil microbial community. The Overall Quality Score is an average of all soil health indicator ratings and it includes the aforementioned quality indicators as well as pH, phosphorus, and potassium levels. It should be considered as a general summary for soil quality. The scores range between 0-
high, and greater than 80% is very high.

On 27-Apr, WCCC cover crop was sampled. Dried and coarsely-ground plot samples were reground using a cyclone sample mill (1mm screen) from the UDY Corporation and brought to
Environmental Testing Laboratory where they were analyzed for carbon and nitrogen using gas chromatography. The CC, WCCC, and RotYr2 plots were tilled with a Pottinger TerraDisc on 7-May (Table 2). planter on 7-May in the CC, WCCC, NT,
NTCC, and RotYr2 plots. At planting, 250 lbs ac^{-1} of an 19-19-19 starter fertilizer was applied to all corn plots. The corn variety was Syngenta NK8618-GTA, relative maturity (RM) of 86 days, at 36,500 seeds ac^{-1}.

Table 2. Agronomic information for corn cropping system, Alburgh, VT, 2021.

Location	Borderview Research Farm – Alburgh, VT
Soil type	Amenia silt loam, 0-2% slope
Previous crop	Corn or Alfalfa/Fescue
Plot size (ft)	20 x 50
Replications	4
Management treatments	Tilled continuous corn (CC), tilled rye cover crop (WCCC), 2nd year corn (RotYr2), no-till corn (NT), no-till with cover crop (NTCC), 2nd year perennial forage (RotYr7)
Corn variety	Syngenta NK8618-GTA (86 RM)
Seeding rates (seeds ac^{-1})	36,500
Planting equipment	John Deere 1750 corn planter
Cover crop (2020)	100 lbs ac^{-1} VNS winter rye, 22-Sep-2020
Tillage date	7-May (CC, WCCC, RotYr2)
Planting date	7-May (CC, WCCC, NT, NTCC, RotYr2)

Table 2 (cont'd). Agronomic information for corn cropping system, Alburgh, VT, 2021.

Location	Borderview Research Farm – Alburgh, VT
RotYr7 1st harvest date	

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 Higher rates of digestion lead to higher dry matter intakes and higher milk production levels. Similar types of feeds can have varying NDFD values

RESULTS

Weather Data

Weather data were collected with an onsite Davis Instruments Vantage Pro2 weather station equipped with a WeatherLink data logger. Temperature, precipitation, and accumulation of Growing Degree Days (GDDs) are consolidated for the 2021 growing season (Tables 3 and 4). Historical weather data are from 1991-2020 at cooperative observation stations in Burlington, VT, approximately 45 miles from Alburgh, VT.

With the exception of July which was cooler, the 2021 growing season was warmer and dryer than the 30-year average. There were a total of 2613 Growing Degree Days (GDDs) for corn from May through September 64 GDDs more than the historical average (Table 3). There were a total of 3542 GDDs for forages from April through August 99 GDDs more than the historical average (Table 4). The season was also very dry, ending with a 6.24 inch rainfall deficit.

Table 3. Consolidated weather data and GDDs for corn, Alburgh, VT, 2021.

in perennial forage, did not have a soil health score significantly different from CC. The WCCC treatment had the lowest soil health score.

There were individual soil health metric differences among treatment. NT and NTCC had statistically similar levels of organic matter, active carbon, and aggregate stability. However, after its first year in cover crops, NTCC had lower percent total carbon and total nitrogen. However, NTCC had higher soil respiration than NC. These differences may be that the additional living roots were feeding micro-organisms, but soil samples were taken too early in the season for the micro-organisms to decompose dying cover crop vegetation, thus limiting contributions to soil carbon and nitrogen. With the exception of aggregate stability, depending on the metric, RotYr7 had similar results to either NT or NTCC. RotYr7 had lower aggregate

On 10-Jun, soil samples were collected for PSNT analysis (Table 7). There was no significant difference in corn cropping systems for soil nitrate concentrations or nitrogen recommendations for 25 ton ac^{-1} yields. Mean soil nitrate-N (NO^{-}_{3}-N) among the treatments was 32.6 ppm with a mean N recommendation of 22.3 N lbs ac^{-1}. The highest nitrogen recommendations were in one CC and one NTCC plot for 100 lbs ac^{-1}. Nitrogen was applied to meet these highest N recommendations to all plots on 17-Jun as 25-12-18 at a rate of 400 lbs ac^{-1} (100 N lbs ac^{-1}).

Table 7. Soil nitrate-

Figure 1. Cropping system total yield, Alburgh, VT, 2021.

Standard components of corn silage quality were analyzed and the average quality of first and third harvest of RotYr7 were analyzed for basic quality parameters (Table 9). There were no significant differences among NDF or NE_L among any of the treatments. Among corn treatments, there were no significant differences in ADF, NDFD 30 hr., TDN, or milk lbs ac^{-1}. Among the corn treatments, RotYr2 had higher protein than CC, NT, and NTCC treatments, but was not significantly different from WCCC. This indicates that CC, NT, and NTCC may have benefitted from additional nitrogen applications. RotYr2 had significantly lower milk lbs ton^{-1} than WCCC, but was similar to other corn treatments. RotYr7 had higher crude protein, higher fiber, lower digestibility, lower TDN, lower milk lbs ton^{-1}, and lower milk lbs ac^{-1} than any of the treatments.

Table 9. Impact of cropping systems on crop quality, 2021.

							Milk	
Cropping system	**CP % of DM**	**ADF % of DM**	**NDF % of DM**	**NDFD 30 % of NDF**	**TDN % of DM**	**NE_L Mcal lb^{-1}**	**lbs ton^{-1}**	**lbs ac^{-1}**
CC	7.62[c]	26.1[a]	45.3	54.0[a]	64.0[a]	1.43	2,921[ab]	20,410[a]
RotYr2	8.50[b]	22.8[a]	45.6	55.0[a]	63.0[a]	1.41	2,808[b]	17,454[a]
NT	7.87[c]	24.9[a]	43.6	55.0[a]	64.0[a]	1.46	2,916[a]	

DISCUSSION

The goal of this project is to monitor long-term soil and crop health in these cropping systems. Based on In terms of soil quality, the system with the most recent rotation from sod, RotYr2, performed best overall. Last year, this treatment, fresh out of long-term sod, had the highest surface hardness measurement. This year, there were no significant difference in surface hardness among any of the treatments indicating that one year of tillage significantly reduces surface compaction. We would expect fields with tillage to have less compact surface