NW CROPS & SOILS PROGRAM

2017 Corn Cropping Systems to Improve Economic and Environmental Health

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2017 CORN CROPPING SYSTEMS TO IMPROVE ECONOMIC AND ENVIRONMENTAL HEALTH

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In 2017 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. Yields are important and they affect the bottom line immediately and obviously. Management choices involving crop rotation, tillage, nutrient management, and cover crops also make differences in the long term. Growing corn with practices that enhance soil quality and crop yields improves farm resiliency to both economics and the environment. This project evaluated yield and soil health effects of five different corn rotations: continuous corn, no-till, corn planted in a rotation with perennial forage, corn planted after a cover crop of winter rye, and a perennial forage fescue.

MATERIALS AND METHODS

The corn cropping system trial was established at Borderview Research Farm in Alburgh, VT. The experimental design was a randomized complete block with replicated treatments of corn grown in various cropping systems (Table 1).

Table 1. Corn cropping system specifics for corn yield and soil health, Alburgh, VT, 2017.

Crop	Management method	Treatment abbreviation
Corn silage	Continuous corn, tilled	[redacted]

permanganate and is used as an indicator of available carbon (i.e. food source) for the microbial 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 Dyna Gro D32RR56, which has a relative maturity (RM) of 92 days. The winter rye cover crop in the NC, CC, and WCCC treatments was plowed on 13-May.
rows on 13-May with a John Deere 1750 corn planter at 34,000 seeds per acre. At planting, 250 lbs per acre of a 10-20-20 starter fertilizer was applied.

Table 2. Agronomic information for corn cropping system, Alburgh, VT, 2017.

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), tilled fescue (NC), no-till (NT), perennial forage (PF)
Corn variety	Dyna Gro D32RR56 (92 RM)
Seeding rates (seeds ac^{-1})	34,000
Planting equipment	John Deere 1750 corn planter
Plow date	13-May
Planting date	13-May
Row width (in.)	30
Corn Starter fertilizer (at planting)	250 lbs ac^{-1} 10-20-20
Chemical weed control for corn	3 qt. Lumax® ac^{-1}, 5-Jun 1 qt Round-Up® ac^{-1}, 5-Jul
Additional fertilizer (corn topdress)	300 lbs ac^{-1} Agrotain (46-0-0), 5-Jul
Forage 1st cut date	30-May
Forage 2nd cut date	7-Jul
Forage 3rd cut date	18-Sep
Corn harvest date	18-Sep

On 5-Jun, 3 quarts of Lumax® were applied per acre for weed control on corn plots. A subsequent application of 1 quart of Round-Up® was applied per acre for weed control on 5-Jul. Corn was topdressed with nitrogen fertilizer by broadcast according to Pre-Sidedress Nitrite Test (PSNT) recommendations on 5-Jul (Table 6). The PSNT soil samples were collected with a 1-inch diameter Oakfield core to six inches

Agricultural and Environmental Testing Laboratory using KCl extract and ion chromatograph.

length of the plot (50 feet). Corn borer and corn rootworm populations were based o

generalizations about data, but other considerations should be analyzed when including milk per ton or milk per acre in the decision making process.

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 corn cropping systems were treated as fixed. Treatment 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.

Soil Data

On 5-May, before planting corn, soil samples were collected on all plots (Table 5). Overall, treatments that were in PF had superior soil quality when compared to any of the corn cropping systems. For the last three years, the PF treatments consistently had significantly higher soil respiration than other treatments. This year, CC, NC, and WCCC treatments had overall better soil quality in terms of the highest available water capacity, lower surface hardness, and lower sub-surface hardness. Percent organic matter was highest in the PF (4.22%) treatment.

Table 5. Soil quality for five corn cropping systems, Alburgh, VT, 2017.

Corn cropping system	Aggregate stability %	Available water capacity (m/m)	Surface hardness Psi	Sub-surface hardness psi	Organic matter %	Active carbon ppm	Soil proteins (N mg/ soil g)	Soil respiration (CO_2mg/ soil g)
CC	19.7	**0.230**	**59**	**165**	3.48	566	7.44	0.454
NC	34.5	0.221*	65*	168*	3.77	540	7.90	0.581
NT	43.7	0.210	88	181*	3.63	540	7.76	0.504
WCCC	22.9	0.215*	69	173*	3.46	494	7.02	0.516
PF	**56.3**	0.206	110	322	**4.22**	**590**	**8.81**	**0.846**
LSD (0.10)	7.41	0.020	8.64	18.75	0.272	NS	0.713	0.062
Trial Mean	35.4	0.216	78	202	3.71	546	7.79	0.580

Pest and disease scouting occurred when corn was in V3 stage on 14-Jun and at harvest (data not shown). No disease was noted at the V3 stage. However, pest pressure was slight. There was an average of less than one pest (corn borer, cut worm, or armyworm) per plot in CC and WCCC treatments. NC had an average of two pests per plot and NT had an average of three pests per plot. Notably, there were zero corn borers in the CC treatments and zero cut worms in the NT treatments. At harvest, rust was identified in all plots. The CC and NC plots had an average of 1.75 corn plants infected per plot and NT and WCCC had an average of 1.25 plants infected per plot. The CC test plots did not have any pest damage at harvest time. All other treatments had an average of 0.25 corn borers per plot.

Table 7. Corn silage population, harvest dry matter and yield by treatment, Alburgh, VT, 2017.

Corn cropping system	Harvest population plants ac^{-1}	Harvest dry matter %	Yield at 35 DM t ac^{-1}
CC	32,000	34.0	22.5
NC	**33,250**	**35.4**	22.0
NT	27,625	34.0	21.4

Table 8. Impact of cropping systems on corn silage quality, 2017.

Corn cropping system	CP % of DM	ADF % of DM	NDF % of DM	TDN % of DM	NE_L Mcal lb^{-1}	Milk lbs ton^{-1}	Milk lbs ac^{-1}
CC	8.0	**23.6**	39.0	78.0	0.763	**3,754**	