Northern NY Agricultural Development Program
2019 Final Report

Assessment of Corn Yield Potentials with Yield Monitors in Northern New York (Phase 3)

Project Leader:

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Collaborators:

- NNY producers (10 to date) with yield monitors
- Eric Beaver and Mike Contessa, Champlain Valley Ag
- Terry McClelland and Justin Bach, McClelland's Agronomics
- Current Cornell campus collaborators: Dilip Kharel, Ben Lehman, Greg Godwin, and Karl Czymmek (PRO-DAIRY). Past contributors: Tulsi Kharel, Sheryl Swink, and John Steele. Project involves NNY producers with yield monitors.

Background:

Over the past three years (2017-2019), we evaluated corn silage and grain yield monitor data for Northern New York (NNY) farms as part of Northern New York Agricultural Development Program (NNYADP)-funded projects to also evaluate the Cornell yield potential database for corn and associated nitrogen (N) recommendations and potential for phosphorus (P) removal through yields.

Initial assessment of raw yield data showed such datasets contain a variety of errors due to machine and operating characteristics including a time lag of grain and silage flow between harvest and sensor recording locations, overlapping of harvest passes that result in low yield errors, start and stop delays, changes in velocity and other flow and moisture sensor errors. A standardized, semi-automated approach to data cleaning was essential if the goal is to generate reliable yield maps across fields, across years, and across farms (as in the development of a statewide database). Such a protocol was developed in 2018 and a manual (http://nmsp.cals.cornell.edu/publications/extension/ProtocolYieldMonitorDataProcessing2_8_2018.pdf). was made available for farmers and crop consultants interested in data cleaning that year.

With participation of farmers and consulting firms in NNY, we aimed to compile a dataset of yield data for corn silage and corn grain in NNY, so that soil type-specific yield potentials can be developed for soil types of agricultural importance to the region, while also contributing to the statewide yield potential database.

Methods:

Data were obtained from ten farms in NNY. This included grain and silage yield data. All datasets were cleaned of errors using the standardized data cleaning protocol developed for NY (as noted earlier). Farmers who participated received their own farm reports (yields with and without headlands and for whole fields as well as per soil type within fields and across the farm), which allows for setting of field-specific yield goals and, where sufficient datapoints are available, also soil type-specific yield potentials. Once reports were generated, data were included in a statewide database. The database was used to generate yield-frequency histograms per soil type (distribution of yield across all fields with yield data for a specific soil type) and once all 2018 data were included, yield potentials were determined for soil types with at least 50 datapoints (fields). Additional training materials were needed to help consultants and farmers understand the importance of data cleaning (in addition to proper calibration of equipment), and to explain steps involved with data cleaning.

Results:

With the NNYADP funding for phases 1-3, we completed data cleaning for seven NNY farms that supplied corn silage data and four NNY farms that supplied grain data. In collaboration with farmers and farm consultants in NNY, we expanded our dataset with 311 fields harvested for silage and 139 harvested for grain (Table 1). Yields averaged 17.8 tons of silage per acre and 187 bu of grain per acre for 2018, but ranges were large, with maximum yield for individual fields reaching 28 tons per acre and 249 bu per acre.

The data from these farms also allowed us to look at yield per specific soil type. Silage yields were documented for nine soil types in NNY, ones for which we had data from 50 or more fields. The summary showed average yields that ranged from 14.6 tons/acre for Bernardston to 22.0 tons/acre for Bombay (Table 2). Grain yields ranged from just below 140 bu/acre for Malone and Muskellunge soils to a high of 175 bu/acre for Rhinebeck (Table 2)

Table 1: Summary of silage yield (ton/acre) derived from 7 NNY farms and grain yield (bu/acre) derived from 3 NNY farms. SD = standard deviation (to determine ranges).

Year	Mean	Standard Deviation	Median	Minimum	Maximum	Fields
Silage	ton/acre	ton/acre	ton/acre	ton/acre	ton/acre	number
2011	18.9	2.5	18.4	13.6	24.0	27
2012	17.1	1.9	17.1	13.6	20.9	28
2013	19.3	3.4	20.2	8.6	23.6	55
2014	20.6	2.9	21.0	12.2	26.4	71
2015	18.5	4.1	19.1	7.2	27.7	115
2016	20.0	4.8	20.6	5.6	29.6	111
2017	18.0	5.4	17.3	5.7	34.0	268
2018	17.8	4.5	17.8	7.9	28.2	311
Grain	bu/acre	bu/acre	bu/acre	bu/acre	bu/acre	number
2011	139	23.5	133	109	183	15
2012	168	17.8	167	137	193	14
2013	110	35.1	103	63	200	14
2014	127	41.1	117	31	242	71
2015	148	23.6	151	72	204	96
2016	141	31.7	136	86	208	16
2017	166	32.4	163	86	236	98
2018	187	28.0	188	106	249	139

Table 2. Corn yields by major soil type from seven NNY farms with corn silage data and three NNY farms with grain data (soil type included data for at least 50 fields).

Soil type	Mean	Standard Deviation	Median	Minimum	Maximum	Fields
Silage	ton/acre	ton/acre	ton/acre	ton/acre	ton/acre	number
Bernardston	14.6	2.3	14.5	10.7	20.7	57
Bombay	22.0	3.2	21.5	15.1	30.5	74
Collamer	18.9	3.9	19.5	8.5	26.2	74
Elmwood	19.4	3.3	19.2	12.1	27.4	77
Farmington	20.1	4.6	21.2	8.6	26.9	53
Galway	21.6	4.5	21.0	9.2	29.9	61
Grenville	19.2	4.0	19.3	8.1	27.4	125
Hogansburg	19.4	3.8	19.5	9.1	27.6	237
Hudson	16.9	4.5	17.0	7.5	26.7	107
Malone	19.6	3.9	19.6	9.7	29.3	138
Muskellunge	19.8	4.2	20.2	9.0	29.6	114
Niagara	17.8	4.1	18.5	7.2	24.0	52
Rhinebeck	16.6	4.5	17.1	7.2	27.1	86
Swanton	19.3	3.5	19.5	10.2	27.5	177
Grain	bu/acre	bu/acre	bu/acre	bu/acre	bu/acre	number
Covington	144	30.2	140	79	233	56
Hogansburg	143	27.7	149	65	191	117
Hudson	174	46.6	185	44	250	85
Malone	139	33.9	146	23	199	83
Muskellunge	140	34.2	149	50	203	77
Rhinebeck	175	43.3	183	74	255	80
Swanton	144	33.7	151	67	208	53

The combined yield-frequency histogram showed an average yield across all farms and years of 19.1 ton/acre and 158 bu/acre (Figure 1), somewhat lower than the assessment for the entire state, which shows an average yield of 19.6 tons/acre and 175 bu/acre.

The NNY data contributed 26% of the silage data and 12% of the grain data to the statewide dataset. Examples of yield-frequency histograms for two soils of relevance to NNY with both silage and grain data (Hogansburg and Swanton) are shown in Figure 2.

Northern New York (all fields and years: 2011-2018)

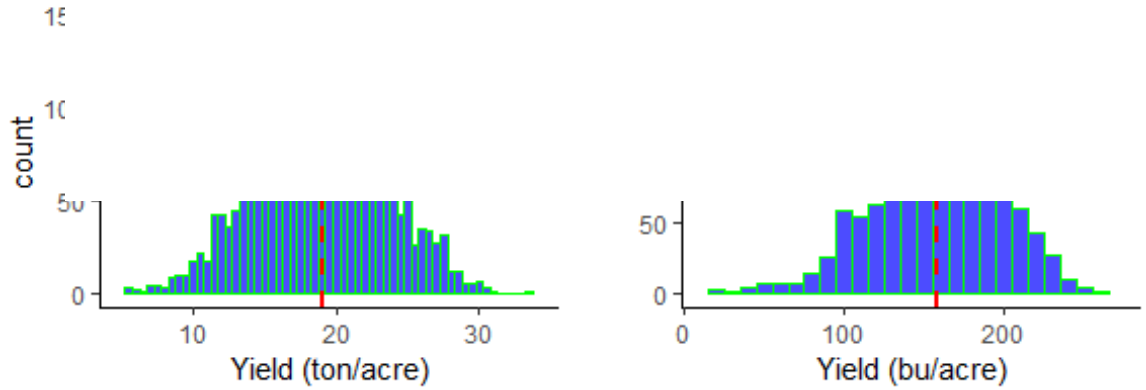

Figure 1: Overall average yield and yield ranges for corn silage (left) and grain (right) based on data from seven farms in NNY who supplied silage data and four farms that supplied grain data.

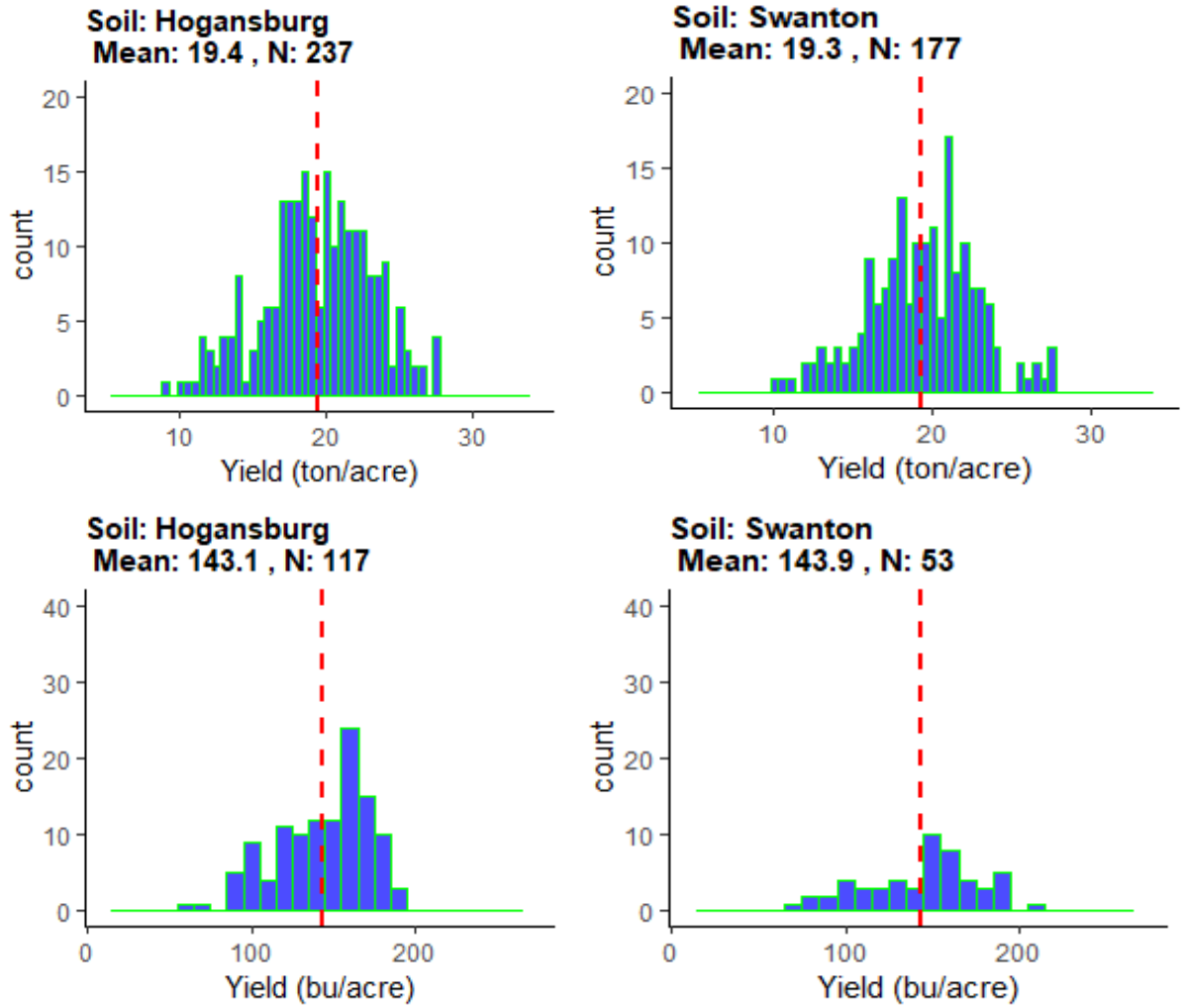

Figure 2: Yield-frequency histogram for Hogansburg and Swanton soils in NNY. Note the larger (and hence more reliable) database for silage than for grain.

Conclusions/Outcomes/Impacts:

With farm-specific yield reports, farmers can now determine their own field-specific or soil type-specific yield potentials. The NNY data will be combined with the statewide data to derive yield potentials for all soils with at least 50 datapoints in the database. A new database will be released with updated values for the following soil types of relevance to NNY:

- Grain: Appleton, Collamer, Covington, Hogansburg, Hudson, Kingsbury, Malone, Muskellunge, Rhinebeck, Swanton
- Silage: Appleton, Bernardston, Bombay, Collamer, Covington, Elmwood, Hogansburg, Hudson, Kingsbury, Malone, Muskellunge, Niagara, Oakville, Rhinebeck, Vergennes

With additional data (2019 harvest) several other soil types can be included in future years (minimum of 50 field x year data are needed). The database is anticipated to grow with more farms and fields being included in the near future, and greater capacity to automate the data cleaning process. Work is ongoing to determine how to address updating of yield potentials for soil series for which insufficient or no data are available, and to evaluate adjustments in the Cornell N equation that uses yield potentials to derive N guidelines for corn production in NY.

Outreach:

The farms that shared data received their farm-specific yield reports that included yield per year of data submitted, yield per field with and without headlands, yield per soil type within a field (headland areas excluded), and yield distribution per soil type on the farm. A new agronomy factsheet was developed on data cleaning (published on the NMSP Agronomy Factsheet website, see below for link), and we published a new What's Cropping Up? article on data cleaning.

Next Steps:

In 2020, we will (1) add 2019 data to increase the number of soil types with at least 50 data points (minimum of 6 farms); and (2) work with four farms with at least five years of yield data to derive farm-specific yield potential databases (per soil type and per field) using 3, 4, or 5 years of yield data, with and without the option to drop the lowest 1 or 2 years of yield data as currently outlined in the adaptive management process document released in 2018: http://nmsp.cals.cornell.edu/publications/files/AdaptiveManagementGuidelinesFor2018.pdf). For the four case study farms, 2019 season crop N and P removal will be determined and this information will be used to determine N and P balances per soil type and per field. Balances, combined with sampling for corn stalk nitrate (CSNT-N) for a subset of 20 fields (5 fields per farm), will inform our adaptive management policy, giving farms with their own yield data the option to be more farm-specific and field-specific than could be the case if assessments were based on statewide averages.

Acknowledgments:

In addition to NNYADP funding, we received a USDA-NIFA-AFRI grant (statistical approaches to analyzing of on-farm trials; data cleaning manual), as well as Federal Formula Funds (statewide yield potential assessment) and, in 2019, a New York Corn Growers grant. These funding sources allow for a statewide approach to yield potential assessment and updating of the Cornell yield potential database.

Reports/articles in which results of this project have already been published:

Website updates:

- Information about corn yield monitor data sharing can be obtained from the NMSP yield potential project site: http://nmsp.cals.cornell.edu/NYOnFarmResearchPartnership/YieldDatabase.html. This website has instructions for corn yield monitor data transfer to the NMSP team for cleaning: http://nmsp.cals.cornell.edu/NYOnFarmResearchPartnership/Protocols/YieldMonitorDataSharingInstructions.pdf and the link to the post-harvest data cleaning manual as well: http://nmsp.cals.cornell.edu/publications/extension/ProtocolYieldMonitorDataProcessing2_8_2018.pdf).

New agronomy factsheet:

- Agronomy Factsheet #107: How and Why to Clean Corn Yield Monitor Data: http://nmsp.cals.cornell.edu/publications/factsheets/factsheet107.pdf

Additional extension article:

- Swink, S.N., T. Kharel, D. Kharel, A. Maresma, E. Haas, R. Porter, K.J. Czymmek, and Q.M. Ketterings (2019). Increase yield monitor data accuracy and reduce time involved in data cleaning**.** What's Cropping Up? 29(1): 6-7. https://blogs.cornell.edu/whatscroppingup/2019/02/06/increase-yield-monitor-data-accuracy-and-reduce-time-involved-in-data-cleaning/.

The peer-reviewed journal article on the data cleaning protocol was published in 2019:

- Kharel, T.P., S.N. Swink, A. Maresma, C. Youngerman, D. Kharel, K.J. Czymmek, and Q.M. Ketterings (2019). Yield monitor data cleaning is essential for accurate corn grain/silage yield determination. Agronomy Journal 111: 509-516. doi:10.2134/agronj2018.05.0317.

For More Information:

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