Advancing sustainable cropping systems for dairy in the Northeast
Heather Karsten¹, Apurba Sutradingh², Kristy Borelli³, Glenna Malcolm¹, Andrew Aschwanden², Doug Beegle¹, William Curran¹, Curt Dell², Jon Hoover², Virginia Ishler², Pete Kleinman³, Robb Meinen³, Tom Richards³, John Tooker²

¹Plant Science, ²Entomology, ³Agricultural & Biological Engineering, ⁴USDA-ARS Pasture Systems and Management, ⁵Animal Science, University Park, PA, USA

Our interdisciplinary team designed two diverse 6-year no-till crop rotations managed with IPM in consultation with an Advisory panel of farmers, experienced cropping systems researchers, and NRCS personnel with the Objectives to:

- minimize off-farm inputs and provide all forage and feed for a dairy herd, and canola fuel for a SVO tractor
- minimize environmental impacts, sustain soil health, and maximize profitability

Methods Crop production experiment simulates a typical PA dairy farm (240 acres with 65 cows) at 1/20th the scale, using farm-scale equipment at the Penn State Univ. Agronomy Research farm. Beginning in 2010, all 6 years of our rotations were planted each year, replicated four times. Nested split plots compare innovative conservation scale, using farm managements for pest rotation and broadcast and injected manure managements for manure rotation.

PEST ROTATION, compares standard herbicide (SH) to multiple-weather-control strategies to reduce herbicide (RH)

MANURE ROTATION: compares same rate of broadcast manure (no-till practice in NE) vs. injected manure (IM)

Results: We monitored weather, all crop inputs (fertilizer, manure, herbicide, insecticide) crop yield and quality, soil fertility, soil quality, milk production, and farm profitability.

Rationale for rotation changes:
- Pest rotation 2013: No-till farmers said they would not use high residue cultivation, post-emergent herbicide split-plot treatment added. Cultivated RH soybean require 30 inch rows; potential SH 15 inch row yield gain tested by addition of 30 inch SH soybeans for comparison of row spacing (Fig. 1, top figure).
- Manure rotation: Dry weather in early years revealed need for another corn entry. Wet falls delayed fall manure & canola planting after corn silage. Slugs damaged canola plant in late fall. So, corn silage, rye silage, & sorghum sudangrass replaced wheat & canola. Sorghum-sudangrass and rye silage provide lower CP feed needed for heifer & dry cows (Fig. 1, bottom figure).

Pest Rotation Yields: Corn RH and SH yields were similar (Fig. 3). In a few years, slugs reduced stands in SH canola and both soy. Higher yields in 15 inch SH soy and when only SH was replanted in 2012. Alfalfa yr3 was terminated in August to plant canola. SH alfalfa monoculture yielded more than RH alfalfa and orchardgrass, likely due to cool season orchardgrass in June, July, August harvests.

Herbicide Use: Pest Rotation: Average herbicide use was reduced by 27% in corn, 19% in soybean, and 40% in alfalfa establishment year, 100% when alfalfa was terminated.

Fertilizer Use: The same rates of manure was applied in BM and IM. Inorganic N fertilizer (starter + side-dress based on PSNT) was reduced in IM by average 42% over the 8 years. Fertilizer P was applied only as starter. Fertilizer K, O need in general declined over time in both rotations (Fig. 4).

Manure Rotation Yields: Crop yields did not differ except in 1 yr. Alfalfa yr2 when BM was higher than IM (Fig. 5).

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