

Sustainable Dairy Cropping Systems Designed to Produce Forage, Feed and Fuel

Our goal is to sustainably produce the forage, feed and fuel for a 65 cow, 240-acre dairy farm in Pennsylvania and to minimize off-farm inputs. With funding from a NESARE USDA grant, our team of PSU and USDA-ARS scientists designed two cropping systems to: 1) minimize nutrient and soil loss, build soil organic matter and nutrient pools, and promote biological processes for nutrient acquisition, 2) enhance biological diversity and ecological interactions, and 3) be energetically efficient, productive, profitable, and sustainable.

We consulted with an Advisory panel to ensure that the cropping systems are relevant to farmers and researchers. Using farm-scale equipment and manure from a neighboring dairy, we initiated the cropping systems in spring 2010 at 1/20th scale on 12 acres of Penn State's Russell E Larson Agronomy Research Farm. The cropping system strategies include two six-year rotations with legumes, cover crops, perennials, no-till, and manure injection. To reduce herbicide-use and herbicide resistance, we are evaluating a combination of weed management practices including a cover crop roller-crimper, herbicides applied over the crop row, a high-residue cultivator, tillage once in 6 years, and companion crops. We have also included a conventionally managed corn-soybean grain rotation for research comparison purposes, which adds another acre to what we manage.

Canola provides fuel for a straight vegetable oil-powered tractor and meal for the dairy ration. Winter canola is included in both crop rotations to evaluate approaches for integrating canola into dairy crop rotations. Preliminary energetic efficiency analysis of the cropping system indicated that 40 acres of winter canola has the potential to produce all of the tractor fuel needs for our 240 acre farm.

To evaluate the performance of the cropping system strategies, we are monitoring performance indicators such as crop yield and quality, soil health, nutrient conservation, greenhouse gas emissions, weed, insect, and mycorrhizal populations; energy use and production; and farm profitability. Twelve field "lysimeter" areas (90' x 50') were installed, to compare the impact of the manure management strategies on nitrogen, phosphorus and soil conservation, as well as atmospheric emissions (ammonia, greenhouse gases). Using the crop yields and feed and forage quality results, two dairy nutrition and production models are used to predict the performance of the virtual dairy herd.

In collaboration with four county educators, eight farmers and four commercial manure haulers, we are also demonstrating manure injection, cover crops, and the roller-crimper on farms in Bradford, Franklin, Lancaster, Lebanon and Berks Counties in PA with funding from a Conservation Innovation Grant from NRCS. We invite farmers in these regions who are interested in trying these practices to contact our project team.

Project Team:

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Sarah Cornelisse, PSU Senior Extension Agent
William Curran, PSU Weed Science
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Roger Koide, PSU Horticulture, mycorrhizal ecologist
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Graduate Students:

Maggie Douglas, Entomology; Emily Duncan, Plant Science; Kristin Haider, Ecology; Robert Meinen, Plant Science; Gustavo Camargo, Ag Engineering; Elina Snyder, Plant Science; James LaChance, Plant Science

Technical Support:

Scott Harkcom, PSU Agronomy Farm Manager
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Undergraduate Research Assistants:

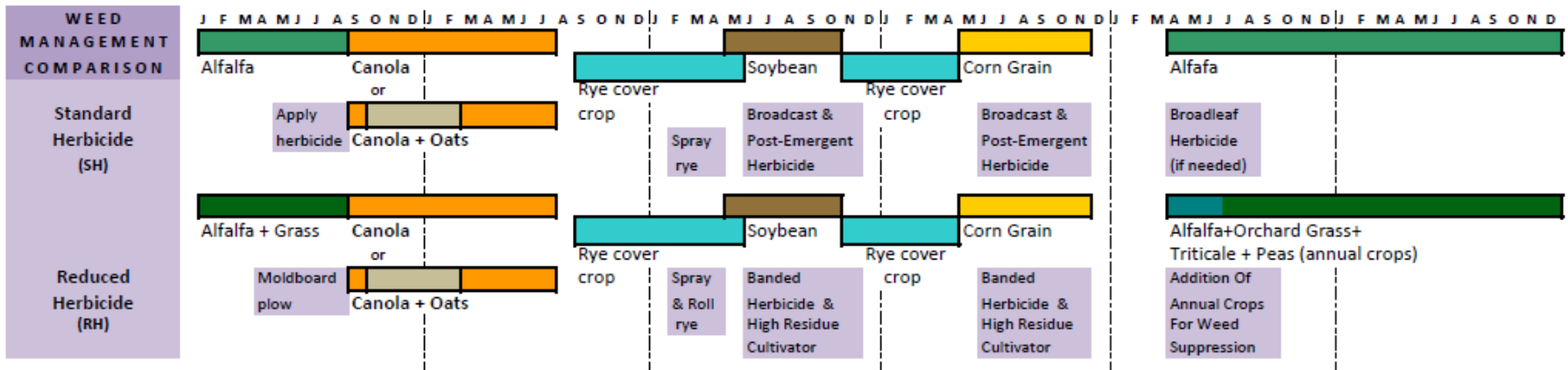
Brian Gray, Joshua Walker, Marissa Keys, Heidi Musshafen, Curtis Kennedy, Andrew Kirk, Andrew Puglia, Fabien Balaguer, Benjamin Crooke, Allison Lush, Sarah Rihl, Adam Seitz



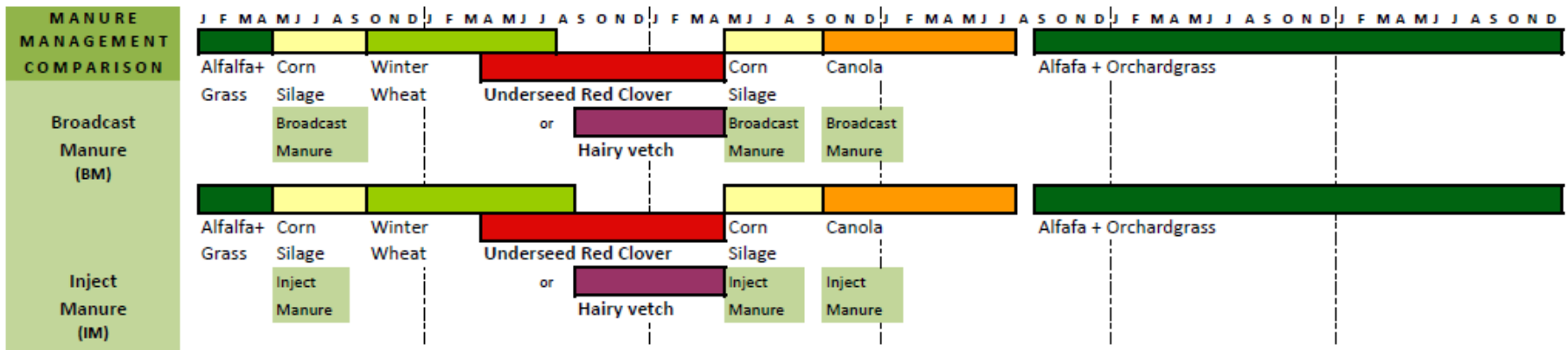
Project webpage: <http://cropsoil.psu.edu/research/cropping-systems>

PENN STATE SUSTAINABLE DAIRY CROPPING SYSTEMS (All systems are no-till, except in one year in the 'Reduced Herbicide Grain Rotation')

GRAIN ROTATION: weed management, canola mycorrhizae management comparison, inject manure regime for canola and corn grain, & IPM for insect pests



FORAGE ROTATION: manure management, green manure species comparison, standard herbicide regime, IPM for insect pests, and conventional corn



CORN-SOY GRAIN CONVENTIONAL ROTATION: manure or fertilizer, standard herbicide regime, prophylactic insecticides, and Bt corn

