

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, integrated pest management, 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. Winter canola provides some of the fuel for a straight vegetable oil-powered tractor and meal for the dairy ration. We have also included a conventionally managed corn-soybean grain rotation for research comparison purposes, which adds another two acres to what we manage.

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.

Project Team:

Craig Altemose (2010-12), PSU Cooperative Extension Dir. Centre Co.
Timothy Beck, PSU Extension Ed., Ag Bus. Management, Cumberland Co.
Douglas Beegle, PSU Soil Science
William Curran, PSU Weed Science
Curtis Dell, USDA-ARS Univ. Park Soil Science
Ronald Hoover, PSU Coordinator of On-Farm Research
Virginia Ishler, PSU Dairy & Animal Sciences
Heather Karsten, PSU Plant Science, Project Director
Peter Kleinman, USDA-ARS Univ. Park Soil Science
Roger Koide (2010-12), PSU Plant Science, Mycorrhizae
Glenna Malcolm, PSU Plant Science, Research Associate/Project Manager
Tom Richard, PSU Agricultural and Biological Engineering
John Tooker, PSU Entomology

PENNSSTATE



College of
Agricultural
Sciences



Natural Resources Conservation Service

Graduate Students:

Anna Busch, Entomology; Gustavo Camargo, Ag Engineering;
Katherine Caswell, Plant Science; Maggie Douglas (2010-2012),
Entomology; Emily Duncan, Plant Science; Kristin Haider (2010-
2012), Ecology; Robert Meinen, Plant Science; Rachel Milliron,
Plant Science; Elina Snyder, Plant Science (2011-2013)

Technical Support:

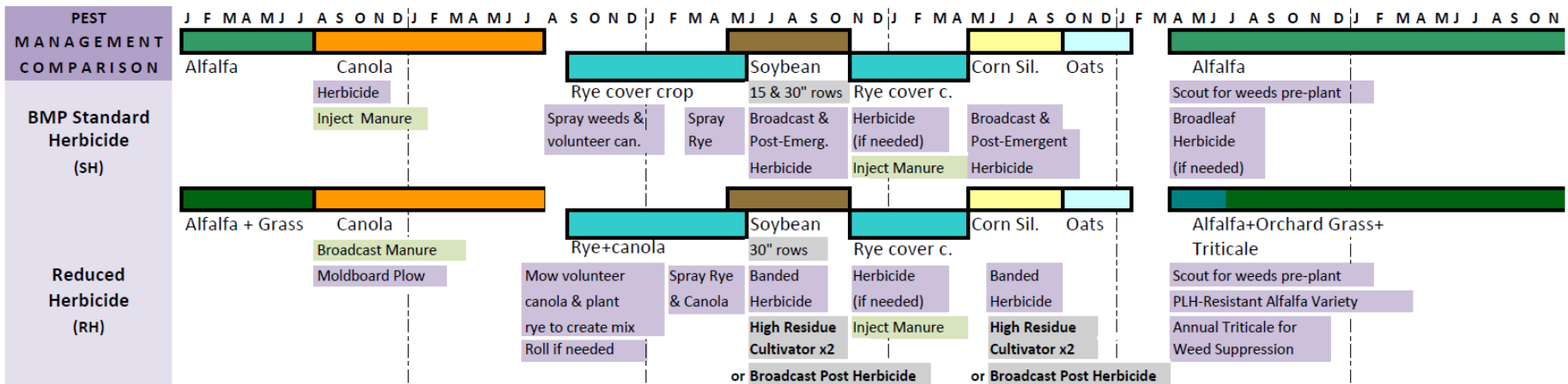
Scott Harkcom, PSU Agronomy Farm Manager
Gordon Folmar, USDA-ARS Univ. Park, Hydrologic Technician
Louis Saporito, USDA-ARS Univ. Park, Soil Scientist
Dave Sandy, PSU Weed Science, Lab & Field Manager
Justin Dillon, PSU Senior Extension Associate
Matt Peoples, PSU Lab Technician, Dept. of Plant Science
Andrew Aschwanden, PSU Lab Technician, Dept. of Entomology
Mark Dempsey, PSU Lab Technician, Dept. of Plant Science

Undergraduate Research Assistants:

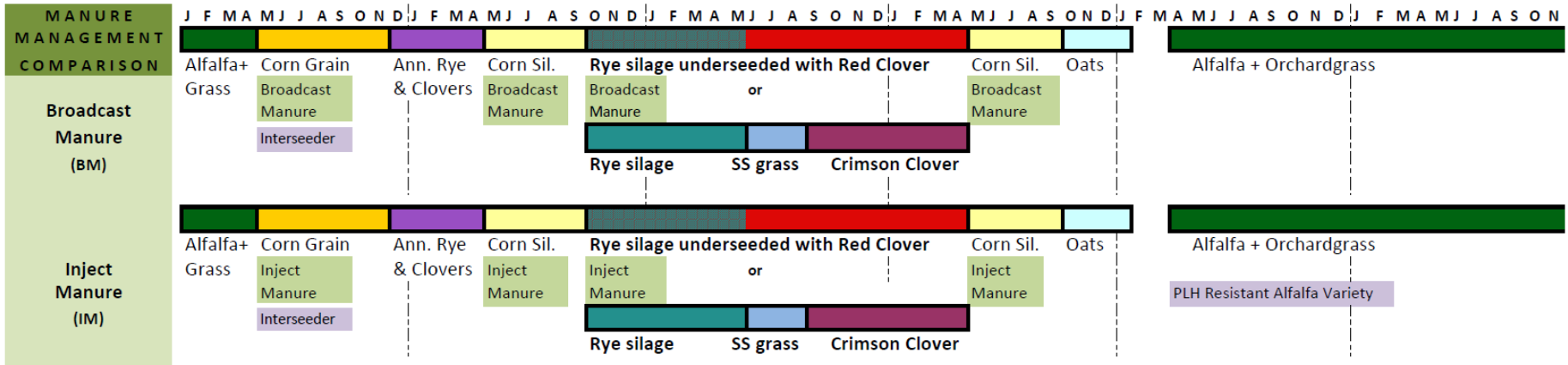
Caitlin Andler, Fabien Balaguer (France), Joy Beam, Benjamin
Crooke, Dianna Duran (Costa Rica), Brian Gray, Elaine Hinrich
(Oberlin College), Allison Lush, Heidi Musshafen, Marissa Keys,
Curtis Kennedy, Andrew Kirk, Roni Pasi, Andrew Puglia, Sarah
Rihl, Samantha Rosado, Erika Samain (France), Julie Schubert,
Adam Seitz, Joshua Walker

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

Pest Management Rotation: IPM for insect pests, multiple tactics for weed control (RH), inject manure for canola (SH) and rye cover crop before corn silage



Manure Management Rotation: injection vs. broadcast manure, green manure comparison, standard herbicides, IPM for insect pests, and non-Bt corn



Corn-Soy Conventional Grain Rotation: manure or fertilizer, standard herbicide regime, prophylactic insecticides, and Bt corn

