UMass Extension

Crops, Dairy, Livestock & Equine Newsletter

SUMMER 2015

VOL. 18:2

Inside this issue:

Editor,

Masoud Hashemi

Upcoming Events:

Professional Development Soil Health Workshop Series: Soil Tests for New England and interpreting them for Phosphorous Management

August 17, 2015 - 3:-5pm
Slobody Bldg., UMass Amherst,101 University Drive, Suite C4
Contact Katie Campbell-Nelson or the website for further information
kcampbel@umass.edu   https://www.surveymonkey.com/r/FSD5HV2

The UMass Hadley Farm Equine Center is hosting the American Hanoverian Society Breed Inspection.

Tuesday, September 8th- @ 9 am. Hadley Farm Equine Center.
For more information, please contact Jill Smith
at jrsmith@umass.edu or 781-603-4521.

Announcements:

The UMass Hadley Farm Equine Center just hosted its first USEF/USDF Level 1 breed show on Saturday, August 1. Over forty horses representing a variety of breeds including Hanoverians, Oldenburgs, and Morgans were presented for inspection. Jill Smith, Director of Riding, hopes to make this an annual summer event.

Nineteen high school students from around the world just completed a 2-credit summer college program at the Hadley Farm Equine Center. The students spent two intensive weeks exploring the equine industry, including equine nutrition, horse judging, pasture management, reproductive physiology equipment operations, veterinary medicine, and sport horse training.

Health Care Practices for our Food Animals 2015: Workshops for Agricultural Service Providers and Farmers

August 13, 2015 – Connecticut – Wamogo Agricultural Science and Technology, 98 Wamogo Road, Litchfield -- 10 am to 1 pm

Food and Drug Administration – "Current Regulations and Compliance Activities" Joseph T. Frost, MPH, RD, CD Commander, US Public Health Service, Investigator, Food Specialist FDA

USDA's Food Safety and Inspection Service --"FSIS Food Safety and Drug Residues" Laura K. Unkauf, DVM, MPH, Supervisory Public Health Veterinarian, USDA FSIS OFO

"Antibiotics in Animals for Human Consumption - Hyperbole, Handwaving, or a Horrorstory?" Nicholas Bennett MA(Cantab), MBBChir, PhD, FAAP, Assistant Professor of Pediatrics Co-Director of Antimicrobial Stewardship, Medical Director, Division of Pediatric Infectious Diseases and Immunology, Connecticut Children's Medical Center

September 10, 2015 – Massachusetts – MA Dept. of Agriculture Satellite Office conference room, 101 University Drive, Amherst -- 10 am to 1 pm

Food and Drug Administration – "Current Regulations and Compliance Activities" Isaac K. Carney, U.S. Food & Drug Administration, Veterinary Drug Specialist

USDA's Food Safety and Inspection Service --"FSIS Food Safety and Drug Residues" Laura K. Unkauf, DVM, MPH, Supervisory Public Health Veterinarian, USDA FSIS OFO

Panel – Veterinarian, Pharmaceutical Representative, UMASS Animal Husbandry

September 23, 2015 – Rhode Island – Building 75 at East Farm, University of Rhode Island, 2163 Kingstown Road, Kingston -- 10 am to 1 pm

Food and Drug Administration – "Current Regulations and Compliance Activities" Karen N. Archdeacon, Compliance Officer, New England District Office FDA USDA's Food Safety and Inspection Service –

"FSIS Food Safety and Drug Residues" Laura K. Unkauf, DVM, MPH, Supervisory Public Health Veterinarian, USDA FSIS OFO Panel – Public Health, State Veterinarian

These workshops are part of a 2014-2017 USDA/NESARE Professional Development Program grant: Health Care Practices for our Food Animals, a joint project among the Universities of Connecticut, Massachusetts, and Rhode Island.

Contact: Jean King jean.king@uconn.edu 860-916-7367 for more information or to register.

Dairy Margin Protection Program (MPP)

Massachusetts dairy farmers who enrolled in the Margin Protection Program (MPP) need to update their MPP plan for the next enrollment period and pay the $100.00 administration fee by September 30, 2015. MPP provides dairy farmers with protection from either falling milk prices or rising feed prices. MPP is a new risk management program included in the 2014 Farm Bill. Growers can select a margin from as little as $4.00 cwt up to $8.00 cwt on minimum of 25% up to 90% of their production. Dairy farmers that enrolled in 2015 will automatically be enrolled in 2016 at $4.00 cwt, which is the catastrophic level. Growers that would like a higher level of coverage must contact their Farm Service Agency (FSA) office. The UMass Extension Risk Management team is available to assist growers in the analysis of their MPP plan.

Dairy farmers can access the MPP decision tool at: https://www.fsa.usda.gov/FSA/pages/content/farmBill/fb_MPPDTool.jsp

UMass Agricultural Field Day

Kelly Kraemer

On June 24, 2015, the University of Massachusetts, Amherst, held its annual agricultural field day at the Crop and Animal Research Education Center in South Deerfield. It was a beautiful day with a successful turnout of over 150 people in attendance, including many farmers, students, researchers, and malters. This event is always open to the public, who can take a guided tour of the farm and learn about current research projects at UMass.

A big draw for the day was Dr. Lynn Adler and her pollinator research. Specifically, Dr. Adler discussed her project that is investigating the effect of bee disease and pollinator strips on pollination services to a main crop. The goal of this experiment is to assess how pollinator strips can affect bumble bee pathogen loads, and how both pollinator strips and pathogen loads affect pollination service to a main crop, which is canola in this experiment. Pollinator strips are areas within farms that are planted with, or are allowed to grow, flowering plants for beneficial insects. These plantings may provide opportunities for farmers to reduce parasite loads, and potentially increase pollination through their choice of hedgerow species.

Another draw to the day was the research in growing malting barley in New England. Over the past two decades there has been an increasing demand for craft beer in the United States, in which barley is a main ingredient. In western Massachusetts, there is an insufficient amount of research regarding varieties and fertility management plans that would permit growers to produce malting quality barley. Consumer demand for locally sourced ingredients is a driving force in a movement to produce quality barley in New England.

Overall, the day was a great success. We would like to extend a big thank you to all of our sponsors, faculty, staff, and student researchers, and especially to farm superintendent, Neal Woodard; their hard work and commitment make this day possible. For more information, contact CDLE Team Leader, Dr. Masoud Hashemi at masoud@umass.edu.

http://wwlp.com/2015/06/24/umass-students-take-part-in-agricultural-field-day/

Dual Purpose Cover Crops for Northeast Dairy Farms

Sam Corcoran and Masoud Hashemi

Cover crops have many demonstrated effects, including erosion prevention, nutrient capture, carbon sequestration, increased soil organic matter, SOM, and overall improved soil health. However, only 17% of Massachusetts dairy farmers plant cover crops efficiently, i.e. on time. As corn silage is the primary source of feed on most farms, corn harvest dates compete with cover crop planting dates, deprioritizing their planting. However, cover crops planted on time offer a dual purpose benefit as they can be harvested as a source of forage. Fall grazing or baling leaves intact root systems and several inches of above ground biomass to maintain soil structure. Likewise, in the spring, post-harvest crop residue builds SOM. These crops also translate to on-farm forage production increases

Feed is the largest annual production expense for dairy farmers in the Northeast. From 2011 to 2014 the cost of feed per animal increased by nearly 47%, reaching $1873 per animal. Increasing on farm forage production can reduce feeding costs, offer new profit opportunities, and improve the resiliency of dairy farms in the oscillating economy of milk production. Shifts in corn production management allow for a September 1st cover crop planting date, which can in turn offer upwards of 7 tons of baleage per acre. To accommodate this system, an early-maturing corn hybrid is planted, allowing for a late August harvest date. After corn harvest, manure is spread, and a winter grain, such as rye, triticale, or wheat, is subsequently planted.

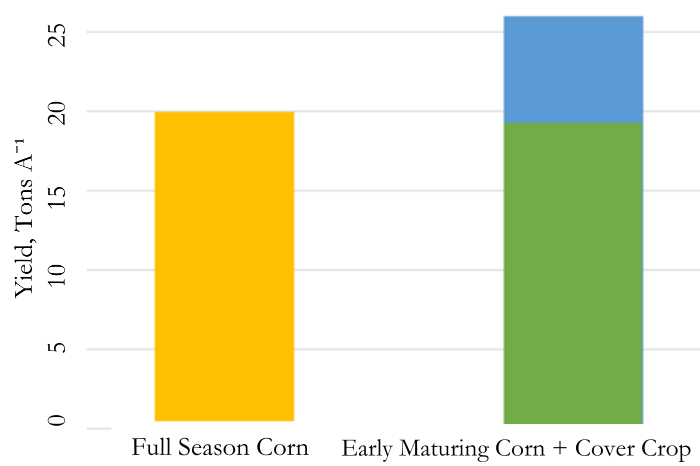

Fig 1. Estimated increased yield with harvested cover crop. Total production in double cropping system with dual purpose cover crops yields more than full maturity corn alone.

Some growers express concerns of a yield penalty associated with early maturing corn hybrids as compared to a full season variety, which is typically harvested in late September to mid-October. However, decades of hybrid trials conducted at the University of Massachusetts, Amherst research fields suggest both the risk, and the penalties, are low. Notwithstanding, we hypothesize that even with a potential yield penalty, double cropping systems of early maturing corn *plus* a harvested cover crop will out yield single cropping systems of full maturity corn (**figure 1**).

Two ongoing experiments at the UMass South Deerfield Research Farm are testing this double cropping system with dual purpose cover crops. In the first experiment, rye was planted in the fall of 2014 at a rate of 110 lbs. A^{-1} on 9/1 (on time), 9/15 (late), and 10/1 (very late), to assess the impact of planting date on nutrient uptake from manure, specifically nitrogen and phosphate, as well as yield and winter survival. Initial results indicate that on time planting is crucial for a harvestable crop in the fall. Both 9/1 and 9/15 planting dates were profitably harvestable on 11/4, however, harvesting the 10/1 planted crop resulted in a net loss, and was not suitable for dual purpose use in the fall (**table 1**). Nutrient uptake followed the same trend relative to planting date as yield, with the 9/1 and 9/15 crops capturing significantly more nitrogen and phosphate than the 10/1 crop (**figures 2 & 3**). We believe differences in nutrient uptake are relative to time, with the third planting date simply not having the time to capture as much nutrient as the earlier planted crops.

Vigorous spring regrowth made explicit quantification of winterkill difficult. However, there were visually obvious variations relative to planting date (**figure 4**)

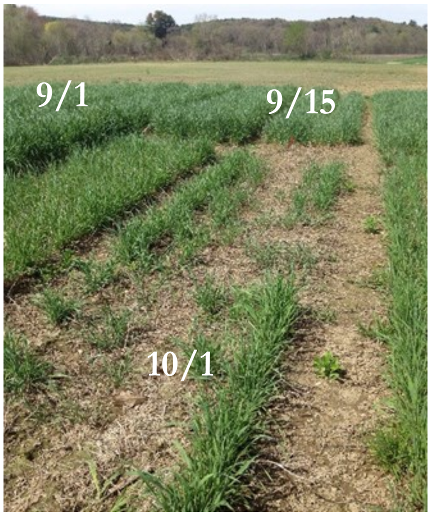

Fig 4. Variations in spring regrowth relative to planting date. Photo taken April 7, 2015.

While some 10/1 crops experienced only minor winterkill, this crop was, overall, more severely impacted than crops planted on 9/1 or even 9/15. Crops planted on 9/15 did take longer than crops planted on 9/1 to establish in the spring, ultimately yielding slightly less than the 9/1 plantings, which were in the best condition after the winter. These observations reinforce the importance of early planting dates, allowing the plants to establish in the fall and properly acclimate to cooling temperatures before winter. However, the results from the first year also suggest that a 9/15 planting date is still suitable for dual purpose use of cover crops, allowing a two week planting window to accommodate for uncontrollable factors such as weather or corn harvest (**table 2**). Combined fall and spring net profit (or savings) potential, as well as baleage yields, for the 2014-2015 season were as follows:

November 4, 2014 Cover Crop Harvest

Planting Date	Avg. tons A^{-1} baleage	Avg. # of 650lb bales A^{-1}	Avg. Net Profit A^{-1}	Average RFV
1-Sep	2	6.3	\$182.39	177.8
15-Sep	1.6	4.8	\$118.73	173.8
1-Oct	0.3	0.9	\$58.14	171.5

Table 1. Estimated yields and profits A^{-1}. Calculations assume \$100 A^{-1} seed expense, \$15/wrapped bale labor, material, and fuel expense, and \$60 value per bale. Financial model is under development.

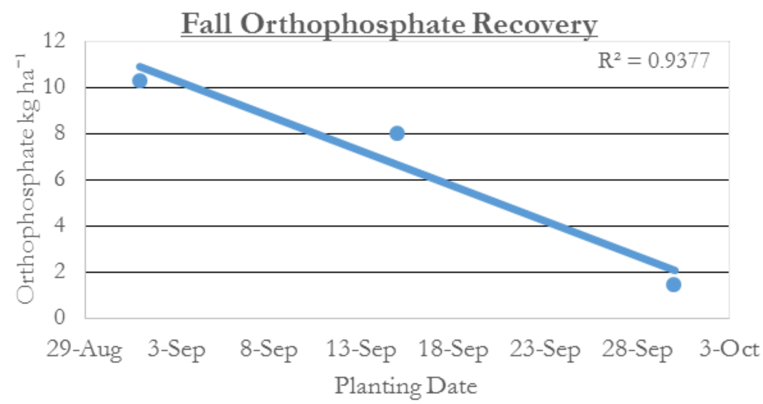

Fig 2. Orthophosphate in rye plant tissue (kg ha^{-1}) relative to planting date, all crops harvested 11/4.

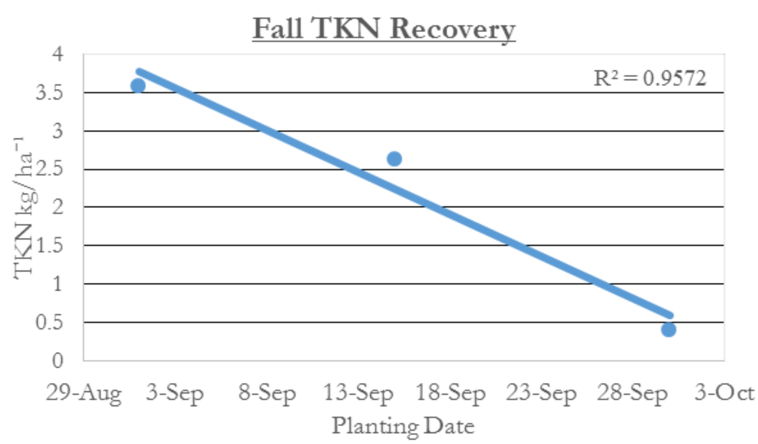

Fig 3. Total nitrogen in rye plant tissue (kg ha^{-1}) relative to planting date, all crops harvested 11/4.

9/1: \$706, 6.9 tons A^{-1} **9/15**: \$567, 5.8 tons A^{-1} **10/1**: \$189, 2.6 tons A^{-1}

A second experiment compares three winter grains, rye, triticale, and wheat, in order to determine the crop most suitable for dual purpose use. All crops were planted on 9/1 at a rate of 110 lbs A^{-1} after manure application. There were no significant differences in terms of yield or nutrient uptake in the fall, with results being comparable to the 9/1 planting date of the previous experiment (**Table 3**, nutrient uptake data not shown).

With the mindset that these are harvestable forage crops, we are investigating the value of spring nitrogen (calcium ammonium nitrate, CAN) application. Each crop received applications of 0, 25, and 50 lbs/CAN A^{-1} in late April once the ground thawed. Rye had the most substantial response to nitrogen application, with crops receiving 50 lbs offering baleage yields over 6 tons A^{-1}, while triticale and wheat also demonstrated significantly higher yields with fertilizer applications of 25 lbs A^{-1}. However, triticale yields at 50 lbs A^{-1} were only slightly higher than triticale that recieved 25 lbs A^{-1}, while wheat yields decreased at the 50 lbs A^{-1} application rate (**table 4**).

Combined fall and spring yield data of these three crops identify rye as the highest yielder, with the best response to fertilizer, and the greatest profit or savings potential (**table 5**). However, wheat was more resilient to delayed harvest, providing higher feed values than both triticale and rye, all of which were harvested 1-2 weeks too late. Repeating this experiment over the next two years will provide the additional information required to make management decisions in terms of which crop is best suited to dual purpose use. However, the "best" crop may vary by farm depending on differences in desired outcome, such a s high yields versus high feed value, as well as differences in preferred management practices, including fertilizer regimes and desired harvest dates.

May 18, 2015 Cover Crop Harvest

Planting Date	Avg. tons A^{-1} baleage	Avg. # of 650lb bales A^{-1}	Avg. Net Profit A^{-1}	Average RFV
1-Sep	4.9	15.0	$523.87	84.9
15-Sep	4.2	12.8	$448.75	89.4
1-Oct	2.3	7.0	$246.70	93.45

Table 2. Estimated yields and profits A^{-1}. Calculations assume $15/wrapped bale labor, material, and fuel expense, and $50 value per bale due to reduced feed value due to late harvest. Financial model is under development.

November 4, 2014 Cover Crop Harvest

Crop	Avg. tons A^{-1} baleage	Avg. # of 650lb bales A^{-1}	Avg. Net Profit A^{-1}	Average RFV
Rye	2.3	7.2	$223.37	156.7
Triticale	2.4	7.3	$228.30	162.8
Wheat	2.5	7.6	$239.94	152.7

Table 3. Estimated yields and profits A^{-1}. Calculations assume $100 A^{-1} seed expense, $15/wrapped bale labor, material, and fuel expense, and $60 value per bale. Financial model is under development.

May 18, 2015 Cover Crop Harvest

Crop & Fertilzer	Avg. tons A^{-1} baleage	Avg. # of 650lb bales A^{-1}	Avg. Net Profit A^{-1}	Average RFV
Rye, 0lbs/N	3.9	12.0	$420.00	88.0
Rye, 25 lbs/N	5.2	16.0	$546.00	92.8
Rye, 50 lbs/N	6.0	18.5	$618.00	90.6
Triticale, 0 lbs/N	3.5	10.8	$376.90	101.3
Triticale, 25 lbs/N	4.6	14.2	$495.40	101.2
Triticale, 50 lbs/N	4.8	14.8	$516.90	100.7
Wheat, 0 lbs/N	3.1	9.5	$333.80	111.9
Wheat, 25 lbs/N	3.6	11.1	$387.70	107.9
Wheat, 50 lbs/N	3.3	10.2	$355.40	109.7

Table 4. Estimated yields and profits A^{-1}. Calculations assume $15/wrapped bale labor, material, and fuel expense, and $50 value per bale due to reduced feed value due to late harvest. Financial model is under development.

Soil data from both experiments, for fall and spring, is currently under analysis, as is nitrogen and phosphate uptake in spring regrowth. Ongoing research will study subsequently planted corn. In the planting date experiment, early, mid, and full maturity corn will be planted after each of the three fall planting dates to study the full spectrum of nutrient management, yield potential, and planting and harvest dates. In the crop comparison study, all early maturing corn will be planted in order to study the influence on corn production. Corn yields obtained in these studies will be compared to USDA data that found silage yields, per acre in the state of Massachusetts, to be 19, 18, and 20 tons A^{-1} in 2012, 2013, and 2014 respectively.

Combined 2014-2015 Profit or Savings Potential and Baleage Yields

Crop & Fertilizer	Avg. Net Profit A^{-1}	Tons A^{-1}
Rye, 0 lbs/N	$643.37	6.2
Rye, 25 lbs/N	$769.37	7.5
Rye, 50 lbs/N	$841.37	8.3
Triticale, 0 lbs/N	$605.20	5.9
Triticale, 25 lbs/N	$723.70	7.0
Triticale, 50 lbs/N	$745.20	7.2
Wheat, 0 lbs/N	$573.74	5.6
Wheat, 25 lbs/N	$627.64	6.1
Wheat, 50 lbs/N	$595.34	5.8

Table 5. Estimated yields and profits A^{-1} by crop and N application. Calculations assume parameters outlined in **Tables 3 & 4**.

For more information:

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2014 Northeast Dairy Farm Summary: https://www.farmcrediteast.com/DFS.aspx
Corn Hybrid Trials at UMass (35 Years): https://ag.umass.edu/crops-dairy-livestock-equine/research/corn-hybrid-evaluation-reports
New England Milkshed Assessment: https://4aa2dc132bb150caf1aa-7bb737f4349b47aa42dce777a72d5264.ssl.cf5.rackcdn.com/Milkshed-combined.pdf
USDA 2014 Crop Production Summary: http://www.usda.gov/nass/PUBS/TODAYRPT/cropan15.pdf

SARE Sustainable Agriculture Research & Education

This research is funded by Northeast SARE.

Current Research Project Snapshots at University of Massachusetts Crop and Animal Research Education Center South Deerfield, MA

Currently moving into the first year of research of cover crop mixtures in malt barley and the second year of nitrogen management and date of planting in winter malt barley production- Caroline R. Wise

It's the second year of nitrogen management of sweet corn after planting fava beans as cool season legume which planted in different date in late summer last year.- Fatemeh Etemadi

Ongoing research in dual purpose cover crops for additional forage production is entering a second year, with planting dates, crop species, fertilizer regimes, and corn hybrids all under analysis. The first year of forage radish and oats for grazing season extension research begins, with an in depth look at radish glucosinolate production as well as changes to free-living and plant parasitic nematodes.- Sam Corcoran

Cover crop cocktail effectively contributes to nutrient uptake and the quality of romaine lettuce (A greenhouse experiment)

Short and mid term impact of biochar application under field condition can significantly affect some soil chemical, physical and biological properties.

Organic fertilizers affect nutrient uptake and nitrate accumulation in lettuce (a control environment experiment) .

- Omid Zandvakili

Current research focuses on forage radish cover crops, including mixtures of forage radish, oats and peas. The main experiment integrates these cover crop mixes with a no-till sweet corn production system. Soil nutrient cycling, cover crop biomass, weed pressure, and corn yield will be evaluated. The second experiment evaluates fall date of planting for forage radish cover crops, with particular focus on fall nitrogen scavenging, cover crop biomass, and spring decomposition nutrient release. - Julie Stultz-Fine

Integrating Cover Crop Mixtures with No-Till Sweet Corn Production

Julie Stultz Fine

The more we learn about soil biology, the more appealing cover crops become. Good yields are inextricably linked to healthy soil, and healthy soil is created by growing plants. Plants, be they cash crops or cover crops, provide soil protection from damaging effects of rain and wind. And living roots feed soil organisms, which in turn release nutrients to crops. So how do we cultivate living plants during the off-season? We have about six months of the year to use cover crops to enhance soil health and subsequent crop health.

There are many cover crops to choose from, each with different benefits, from erosion control to nitrogen scavenging. But if you want to maximize the paybacks provided by cover crops, plant a mixture! Cover crop functions and benefits are multiplied and diversified by a mixture of species.

With my advisor, Dr. Masoud Hashemi, I am researching low-residue cover crop mixtures, including forage radish, which provide the advantages of a warmer soil in the spring and an accessible seedbed as compared to a traditional rye cover crop The goal is to develop a sustainable production system for early sweet corn in the Northeast by integrating the benefits of forage radish cover crops and no-till production.

Fall-planted forage radish (aka tillage radish) efficiently scavenges residual nitrate from the soil after a main season cash crop. The fleshy taproot rapidly depletes soluble soil nitrogen at depths from 60 to 70 inches, exceeding the capability of the more commonly used rye. Large root channels created by the radish provide excellent water infiltration and warmer soil temperature for early planting. The seedbed following forage radish is relatively weed-free and residue-free, therefore optimal for direct seeding in a no-till system.

One of the disadvantages of forage radish is that it has a low Carbon to Nitrogen ratio (C/N ratio), and as a result it decomposes quickly in the spring. If the Nitrogen released by decomposition is not synchronized with the N demand of the corn, then it is lost and is money down the drain. Planting a mixture of cover crop species will adjust the carbon to nitrogen ratio, increasing biomass.

In this research, two mixtures of forage radish cover crop were selected to compare the effects of forage radish and cover crop mixtures on weed suppression and synchrony of decomposition to meet crop demand for N. No cover crop and 100% forage radish were planted for controls. All of the species in these cover crop mixes are winter-killed in New England, which was intentional to simplify spring management.

Treatments:

Forage radish: 7 lbs/acre

Oat/Forage radish: 50 lbs/acre oats + 3 lbs/acre radish

Pea/Oat/Forage radish: 45 lbs/acre peas + 30 lbs/acre oats + 2 lbs/acre radish

No cover crop.

Cover crop mixtures can provide:

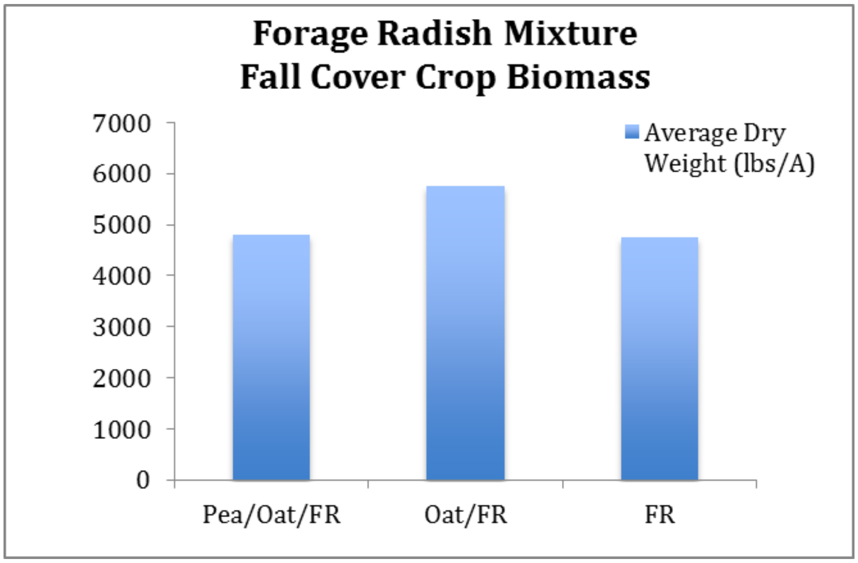
- Diversity in soil biology
- Nutrient scavenging
- Weed suppression
- Improved C:N ratio
- Erosion control
- Increased biomass
- Forage
- Adaptation to soil & weather con-

Cover crops were seeded on August 23, 2014. The above rates were based on the following ratios: 100% forage radish, 70% oats/30% forage radish, and 30% peas/40% oats/30% forage radish by weight. Forage radish is a highly competitive crop, so smaller percentages were used in mixes to assure growth of the other species. Peas are known to be weak competitors, so the proportion of peas was increased.

Cover crop biomass was measured just prior to winter-kill in mid-November 2014. Soil samples were taken at regular intervals from fall 2014 through summer 2015. Fall and spring weed biomass were measured. Sweet corn tissue samples were taken when plants were 12 inches tall, and at post-harvest to analyze the nutritional status of plants according to the cover crop treatment. Sweet corn was harvested on July 30, 2015 and yield is being assessed.

Results:

Cover crop biomass was measured in mid-November 2014. Forage radish (FR) and Pea/Oat/FR had similar biomass yields around 4800 lbs/acre of dry weight. Oat/FR had the highest yield of 5700 lbs/acre of dry weight (Fig. 1). If you're looking to increase organic matter, this high yield of biomass is a great payoff when you consider that the cover crop seed is relatively inexpensive at $29/acre. See Figure 5 for seed cost estimates.



. Figure 1. Fall Cover Crop Biomass

Forage radish is generally known to have a low C/N ratio, but in this experiment there weren't significant differences between cover crop treatments. The C/N ratio of forage radish was 24:1, while oat/FR was 25:1 and pea/oat/FR mixes were 22:1. Overall, these cover crop mixtures had low nitrogen content (between 1.5 to 2.2% N by weight), which raises the C:N ratio. Pea/Oat/FR mixes did not show significant benefit from nitrogen fixation by the peas.

Soil tests showed what much prior research has revealed: in late November all cover crop treatments had scavenged significant soil nitrate compared to the no cover crop plots. All three cover crop treatments showed 2 ppm remaining nitrate, while the no cover crop treatments indicated 25 ppm nitrate. In mid-May 2015 the FR plots had 30% more available soil nitrate than the Pea/Oat/FR and Oat/FR plots, and 70% more nitrate than no cover crop plots. However, by mid-June soil tests indicated that all cover crop treatments had similar levels of soil nitrate.

Figure 2. Complete fall weed suppression by forage radish cover crop in October (foreground).

Figure 3. Forage radish residue and weed suppression in mid-April 2015.

Weed suppression was best achieved by forage radish alone in both fall and spring. In mid-November 2014, forage radish achieved almost total weed suppression while both Pea/Oat/FR and Oat/FR had 3 times the weight of weeds. However, the no cover crop treatment had 54 times the weed biomass compared with FR.

In late April 2015, FR still has the least weed biomass, followed by Pea/Oat/FR , then Oat/FR, with Oat alone being the least weed suppressive. (Fig. 4).

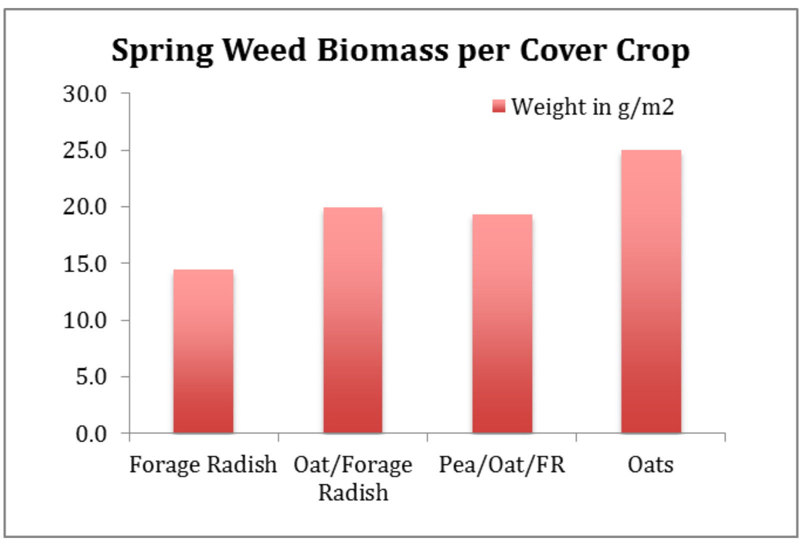


Figure 4. Weed biomass by cover crop.

Seeding and Cost benefits:

Calculating seeding rates for cover crop mixtures is not an exact science, but there are some really good guidelines out there. An excellent resource was recently published on extension.org, entitled "Making the Most of Mixtures: Considerations for Winter Cover Crops in Temperate Climates" (White, C. et al, 2015). It provides a step-by-step approach to selecting species, evaluating their benefits and competitiveness, and determining seeding rates. A link to the article is provided at the end. An additional resource is a free cover crop mixture calculator available at https://greencoverseed.com/smartmix. In general, for each selected species you want to use at least half the seeding rate of the recommended monoculture rate, and even less if you have two similar species (for example, two grasses). Use a minimum of 30 lbs/acre of total seed.

Cover crop mixtures can be a cost-effective and productive way to fine tune and increase the benefits of your cover cropping practices (Table 1) in order to build soil health, provide weed control, and cycle nutrients for next season's crop!

Figure 5. Cover crop species	Seeding rate-drilled (lbs/ac)	Seed price ($/lb)	Seed cost per acre
Oats	100	$0.40	**$40**
Rye	90	$0.25	**$23**
Vetch/ Rye	20/ 60	$2.00/ $0.25	**$55**
Forage radish	7	$3.00	**$21**
Oat/Forage radish	50/3	$0.40/ $3.00	**$29**
Pea/ Oat/ Forage	40/30/2	$1.20/ $0.40/ $3.00	**$66**

Resources:

Clark, A. 2007. Managing cover crops profitably, 3rd edition. Sustainable Agriculture Network, Beltsville, MD. (Available online at: http://www.sare.org/SARE-Nationwide/Learning-Center/Books/Managing-Cover-Crops-Profitably-3rd-Edition)

White, C., et al, 2015. Making the Most of Mixtures: Considerations for Winter Cover Crops in Temperate Climates. [Online]. Available at: http://www.extension.org/pages/72973/making-the-most-of-mixtures:-considerations-for-winter-cover-crops-in-temperate-climates#conclusions

Green cover seed smart mix calculator. [Online]. An online tool to create custom seeding rate blends of many different species. Available at: https://greencoverseed.com/smartmix

SARE Sustainable Agriculture Research & Education

This research is funded by Northeast SARE.