

Warm-season grass selection to balance forage production and wildlife management needs

Final Report for FNE12-740

Project Type: Farmer

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Projected End Date: 12/31/2013

Grant Recipient: Tuckaway Farm

Region: Northeast

State: New Hampshire

Project Leader:

[Charles Cox](#)

Tuckaway Farm

Project Information

Summary:

Conservation properties that are protected by wildlife habitat focused conservation easements create an opportunity to have productive agricultural management compatible with wildlife management. There are tens of thousands of acres of farmland that require regular mowing and maintenance to remain open, and there is also an increasing need for productive agricultural land in New England.

The normal cool season grass hay crop in New England needs to be harvested early in the summer, which can conflict with the nesting season for ground nesting birds. The establishment of warm season grasses that can be harvested later in the season could provide both a nutritionally useful crop, bedding and/or biomass and a safe grassland nesting area for the early summer.

This trial concluded that minimal tillage establishment of warm season grasses such as Indian Grass, Big Blue Stem and Switch Grass is possible with minimal tillage, but that establishment is slow when going into old pasture/hay fields. This report recommends further stressing the sod prior to tillage with repeated mowings or preparation in the prior season. Longer term study will be needed to determine forage or biomass value and longer term species competitiveness, but the second year results looked quite promising with sholder high indian grass and big blue stem clearly established and thriving as part of the species mix.

To begin the process of warm season grass trials in New Hampshire, this project trialed four mixes of warm season grasses recommended for the area using two tillage methods on a property with a wildlife easement owned by the town of Lee NH. The tillage treatments and seed mixes were planted in a randomized split plot design. Plot layout and treatment details are illustrated in the enclosed plot plan. The two tillage treatments were accomplished with an 8' front mounted Howard rotovator and rear mounted Brillion coultipacker. The first pass for shallow (2-3" depth) and deeper tillage (6-8") was done on May 19th 2012. The second pass and seeding was done on May 25th 2012 at recommended seeding rates of 12lbs/acre.

The four plots included mixtures of Big Blue Stem, Indian Grass, Switch Grass, and Eastern Gama Grass.

The end of the first season the establishment was not very evident. By September 2013 Indiagrass was most prevalent, and was often scattered from original plots in areas that were not seeded with it. BigBluestem was also easily identifiable and beginning to grow vigorously. Switchgrass was found in small but clearly identifiable patches but there was no evidence at all of Eastern gamagrass establishing itself in any of the plots. The slow establishment rate of all species did not make forage quality testing or harvest feasible, but did provide valuable insights into field preparation, tillage practices and seeding methods. This trial successfully identified many promising approaches to further reduce tillage, and facilitate a more rapid establishment of warm season grass species, and resulted in conservation programs and informal networks with far greater capacity than when the trial was proposed.

The following tables show that Indian Grass yield was not different in plots where it was planted from where it was not planted – indicating that it was successful in the first season of propagating itself and spreading across the field effectively. Big Blue Stem plots had higher rates in the plots where it was planted but also began showing up in smaller amounts in other plots indicating that it is also successful in reseeding in the first season.

The following images show distribution and intensity of the target populations by color intensity. The key indicates the percent of overall species in the given plot.

- [Indian Grass results](#)
- [Indian plots color coded](#)
- [switchgrass results color coded](#)
- [Warm Season Grass Plot Analysis](#)
- [Big Blue Stem Results analysis](#)
- [Big Blue Stem color coded results](#)

Introduction:

One of the well known challenges in establishment of warm season grasses is transition from old hay field. This is indicated in the seed companies guidelines, which indicate that the most challenging sites for establishing warm season grasses are old pastures or hayfields. Many perennial, cool season grasses which often predominate accumulate too much duff for effective planting. Old hayfields are also a common part of conservation organization's land portfolios and are often costly to maintain by paying to have them mowed. This problem and the requirement to minimally disturb the soil and to only use organic methods are at the core of the problem statement for this trial.

The field being used in this trial fits the profile perfectly and has been managed for wildlife habitat for over twenty years. It has received no amendments, and has only been kept open through rotary or flail mowing between once a year and every other year. The challenge and purpose of this project is to specifically target those kinds of conditions which are typical in many properties managed by conservation organizations. The additional constraint for warm season organic establishment is the desire to create minimal disturbance in the soil profile. Results and documentation of this trial follow with additional discussion will be continued here at [Farmhack.net](http://farmhack.net/node/1261)

The Farm Hack site also contains a google earth plugin which enables limited visualization of the data. To more fully interact with the data the full kmz file can be found, downloaded and opened with google earth at the following [site.](https://sites.google.com/site/kmzhostfarmhack/kmz_kingman_tillage/Ford_layers.kmz).

As previously noted other plants were often dominating, although biomass or quantitative measurements of cover were not completed for this trial. The other species identified were:

Block 1

Phleum pratense Common Timothy
Verbascum thapsus Great Mullein
Solidago canadensis Canadian Goldenrod
Rubus allegheniensis Allegheny Blackberry
Daucus carota Queen Anne's-Lace
Populus tremuloides Quaking Aspen
Rosa multiflora Rambler Rose

Block 2

Phleum pratense Common Timothy
Verbascum thapsus Great Mullein
Daucus carota Queen Anne's-Lace
Solidago canadensis Canadian Goldenrod
Asclepias syriaca Common Milkweed

Block 3

Phleum pratense Common Timothy
Solidago canadensis Canadian Goldenrod
Oenothera biennis King's-Cureall
Turritis glabra Tower-Mustard

- [Soil Health test results prior to planting](#)
- [ford warm season plot results table](#)

Project Objectives:

The establishment of warm season grasses that can be harvested later in the season can provide both a nutritionally useful crop and a safe grassland nesting area for the early summer. The normal cool season grass hay crop in New England needs to be harvested early in the summer, which can conflict with nesting season. This project seeded four mixes of warm season grasses using two tillage methods on a property with a wildlife easement owned by the town of Lee NH.

Conservation organizations and land trusts are now beginning to realize that they need to be able to work with local farmers in order to manage their properties for both food and fiber production and for wildlife habitats, particularly the intensively used edges of fields. The need is to establish a productive hay crop that will make the harvesting process pay for itself and for the mowing of the non-productive fields. There are many acres of farmland in NH that require regular mowing and maintenance to remain open, and there is an increasing need for productive agricultural land in New England. The establishment of warm season grasses that could be harvested later in the season to provide both a useful crop and a safe grassland nesting area for the early summer. More local research needs to be done

in this area to determine the most appropriate varieties of warm season grasses for this area, as well as lower tillage organic methods for establishing them on conservation lands. This project took place on the the Ford conservation property, which was given to the Town of Lee with a conservation easement in order to preserve the land primarily for wildlife. This property and project provides a good testbed, not only for establishing grass species recommendations, but also for outreach and organizational partnerships, and the development of biological and mechanical knowledge and a baseline example from which to build upon.

- [Indian Grass and Big Blue Stem seed heads 2013](#)
- [Switchgrass and Indian Grass seed heads 2013](#)

Cooperators

- [Dr. Matthew Tarr](#)

matt.tarr@unh.edu

Extension Associate Professor/Specialist, Wildlife

University of New Hampshire

Nesmith Hall 131 Main Street

Durham, NH 03824

(603) 862-3594 (office)

Research

Materials and methods:

The seedbed preparation and seeding at the prescribed rates was successful. Plot layout and treatment details are illustrated in the enclosed plot plan. Tillage was accomplished with an 8' front mounted Howard rotovator and rear mounted billion coultpacker. The first pass, called treatemnt A, was shallow (2-3" depth) and deeper tillage (6-8"), called treatment B, was done on May 19th 2012. The second pass and seeding was done on May 25th 2012.

The Billion seeder was used with a coultpacker before and during seeding. All seeding was done with a 30 pound oat and 20% Virginia wild rye nurse crop as recommended by the seed company.

The seed rates were the same for all treatments at 12 pounds per acre but at the following ratios per treatment

Treatment	Grass ratios
1	33% BIG BLUE STEM 32% INDIAN GRASS 15% SWITCHGRASS
2	53% BIG BLUE STEM 27% SWITCHGRASS
3	80% EASTERN GAMAGRASS

The front small seed box on the Brillion seeder was calibrated for switch grass and big blue stem, while the back seed box with agitator was calibrated with the oat, wild rye, Indian grass and Gama grass mixes. Calibration was done prior to arriving at the field by using a tarp under the seeder and turning the drive sprocket to simulate the seeding of one tenth an acre then multiplying the weight of seed by ten.

After planting the plots were mowed with a Kuhn flail mower set at 6" in the first week of August 2012 to reduce weed pressure. Emergence of the warm season grasses was very difficult to identify individually by species in the first season, but were identifiable by the NRCS State agronomist.

In the fall of 2013 the emergence of the distinctive seed heads and tall stature of the grasses made the identification far easier. In October 2013 transects were laid out and population counts conducted which included three samples from each plot. The plot layout and collection locations are included as attachments to this section.

Population identification and quantification was performed by Marty Michener. Who is the author of *Botany Everywhere*, which examines plants in New England and their cultural conditions. Mr Michener holds a PhD in biology from Harvard University and a BS in biology from Cornell University. He is president of MIST Software Associates and a consultant for AMRO Environmental Laboratories. Marty has taught at Antioch University New England and served as the former executive director of the New England Institute for Environmental Studies.

Based on the seed company recommendations the pH of the soil was within the recommended range for conservation practices but not for forage. The seed company recommended a pH level of 5.0 for conservation cover and a pH of 6.0 for forage production. No nitrogen was added, and the soil had low active carbon and biological activity. The seed company suggests that by maintaining a healthy vigorous stand of warm season grasses, the possibility of broadleaf weed or woody invasion problems is minimized. Wood ash was applied an even strip at 4 tons per acre to test the sensitivity to pH and K, but no visible difference was apparent in the plant populations or ratios. Because there was no visibly difference identifiable the strip where wood ash was spread was not sampled separately.

Please see future recommendations for discussion about improvements to the seeding and seed bed preparation.

- [Plot layout prior to planting](#)
- [Aerial image of the warm season grass plots after almost one season](#)
- [Plot layout and location of samples](#)
- [plot tillage with unimog, howard rotovator and brillion seeder](#)

Research results and discussion:

The objective to establish a forage quality grass in two years was not met. However, the spread of the grass species beyond the bounds of the plots indicates a clear change in the overall species mix.

The lack of Eastern Gamagrass emergence suggests that the seeding method was not appropriate, and upon further research found that using a corn planter for

singulation and to plant in a deeper seedbed may have yielded better results than the Brillion coultipacker which tends to plant closer to the surface. Future trials might separate the gamma grass out or use a no-till drill with the forward seed box dropping the seed directly behind the disk opener.

Early and repeat mowing prior to establishment would also be part of future treatments to further stress and reduce competition during early establishment.

The lack of significance of tillage practices and also the variation of establishment by block also indicates that soil conditions are likely to be more important than tillage.

The long establishment time is consistent with the few other plots that USDA, NH Audubon and other conservation organizations have experienced.

This trial also inspired an additional two plots - one on TNC land - six acres in much more fertile Buxton sandy loam soil and another no-till trial on private land on bay road in Newmarket. The TNC field in particular will be interesting because of its more intensive agricultural history, higher fertility and different weed seed bank.

Agencies and individuals continue to watch and learn about the now more numerous results

Research conclusions:

There were several objectives for this project but most important was the establishment of warm season species to enable the future performance of the grasses for agricultural and conservation purposes. Of the four species three were successfully established to a level that was a measurable part of the plant population by the second season. While they did not establish to a level to warrant forage testing or harvest, the trial did expose many important aspects that will benefit future understanding of both mechanical and biological systems. In addition to reinforcing the reputation of warm season grasses for a slow establishment rate, the trials also exposed that the variation of the population across field blocks with the same seeding rate and methods was more sensitive to field conditions other than the particular tillage method.

A light soil disturbance in the top two inches was as effective as deeper tillage to 6-8" in this trial. The existing sod conditions had few vegetatively reproductive species (like crab grass) and was more dominated by golden rod and or perennials like common timothy that reseed themselves.

The seed bed prep and seeding process also identified and developed local knowledge around the mechanical challenges of seeding warm season grasses. This resulted in an important contribution too. The variety of warm season grasses that were tested had very different shapes and sizes and ideal planting depths. The method used with the Brillion seeder worked fine for most except for the Eastern Gama Grass, which was likely planted too shallow. The calibration and mixtures were also very time consuming to create and adjust. This process highlighted the advantages of conservation no-till drills with the multiple seed boxes and the warm season boxes with agitators and large seed tubes.

At the time of the trial there were not any available, but within the frame of the trial, two were purchased and demonstrated by conservation districts. In addition to the drills purchased by the Strafford and Cheshire County Conservation Districts, the Granite State Graziers also purchased a third drill in the fall of 2013.

The Strafford County drill was initially delivered without the warm season box, but will be retrofitted in the spring of 2014. This trial helped build the case and local knowledge base to use the improved equipment and create a new valuable service of equipment lending through the conservation districts.

- [Cheshire County No-till Drill with Warm Season Grass box](#)
- [Strafford County No-till drill will be fitted with warm season seed box](#)
- [Cheshire County No-till Drill and field day in 2012](#)

Participation Summary

Education & Outreach Activities and Participation Summary

PARTICIPATION SUMMARY:

Education/outreach description:

This project largely followed its publicity and outreach plan. The trials were referenced at NOFA NH, NOFA VT, USDA Covercrop symposium, and Granite State Graziers conferences and was part of more than half a dozen field walks with UNH classes, USDA/NRCS, NH Audubon, The Nature Conservancy, and Conservation commissions. The USDA State Agronomist and Ecologist collaborated on warm season grass field walks which included plots developed by NH Fish and Game and NH Audubon. In addition, this project was referenced by and helped inform conservation district soil health workshops and no-till drill demonstrations. The Conservation District programming happened off site but referenced this project as a potential future application for their equipment lending program.

This project was also referenced by Strafford County Conservation District in their successful proposal to fit their no-till drill with warm season boxes. The plots developed by this trial are also located on town of Lee land and were labeled so that citizens visiting during passive recreation were exposed to the project and its objectives.

In 2013 the Nature Conservancy contracted with USDA to duplicate a portion of this trial with similar objectives on a six acre portion of a conservation field, and a private landowner has also since used the findings to help establish a native meadow in Newmarket New Hampshire. The project has also been posted on Farmhack.net with the intention of having the work and a version of this report become a starting point for future trials and interactions with other farmers questions and ideas.

Project Outcomes

Assessment of Project Approach and Areas of Further Study:

Potential Contributions

This trial established a known baseline conditions and provided a significant contribution to the ongoing and larger conversation about wildlife management, farming, ecosystem services. It has also contributed to the exploration of organic and low till low disturbance methods for transitioning species and creating diversity in grass mixes with varying growth cycle patterns.

This project has also made contributions to the appropriate infrastructure to implement new conservation strategies. From when this proposal was submitted to it being implemented, two conservation districts purchased and developed programs around no-till drills with warm season boxes as well as small and large seed boxes to enable simultaneous seeding of large seeded species like Eastern Gama Grass, fluffy seed like Indian grass, and small seeds like Switch Grass and Gama grass to be seeded at different rates and depths all in a single pass. It is unlikely that without this ongoing trial the importance and use of those seed boxes would have been made clear in the development of that program.

This trial also clearly showed that slow multiyear establishment is to be expected and not an indication of future failure. The same process is currently underway with conservation plot plantings for pollinators, and has been helpful to set landowner expectations.

The lack of difference between the low disturbance and greater tillage also highlighted the need for additional work in organic methods to transition species into sods and forages. This trial provides a base to build on with future work that may use repeat grazing or stress from previous mowing. The challenges and slow establishment also highlighted the need for additional organic methods for transitioning species mixes and adding diversity into sods and forages.

Future Recommendations

This project highlighted that studies longer than two years will be necessary to properly evaluate warm season grasses, but that there is still value in shorter term evaluation of field practices.

Beyond the warm season grass aspects of this trial, the project highlights several very promising approaches to organic establishment methods and transitions that builds on other ongoing work.

The potential for testing new approaches has also increased since the original proposal was developed through the increase in availability of equipment like aerways, and no-till drills and other similar equipment by conservation district equipment lending programs.

In particular the potential for light surface tillage and disking, and much earlier fall and spring preparation in hay field conditions for late April to June plant dates. Future approaches would likely include repeated fall and spring mowing to stress and reduce energy reserves of the baseline plant population coupled with minimum tillage and techniques explored in farmer/grower SARE proposal titled: Mechanical approaches to perennial weed suppression in organically established no-till cover crops.

These methods coupled with shallow tillage are promising especially when coupled with the newly available no-till seed equipment which can more accurately meter

and place seed at the appropriate depth and conditions. ??

The original proposal for this trial mentioned the possibility of testing the yeoman's plow with undercut bars, however that proved to be too immature a technology and was not functioning well enough to include in the plot trials. However, future work, with the benefit gained from the SARE trials could include a far more extensive mowing or grazing preparation and use of a sweep plow set up or yeoman's with undercut bars.

This future work continues to demand more understanding of soil conditions including moisture, chemistry analysis and baseline plant population interactions.

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