2017 NE SARE Farmer Grant
COVER SHEET

Project Title	Single-producer-scale preparation of warm season grass for poultry bedding
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PROJECT SUMMARY

Producers of landscape-friendly, sustainably-produced warm season grass (WSG) crops face a market climate with few well-developed, high-value uses for their crops. Poultry bedding markets, where WSGs have performed well, offer a compelling opportunity; however, the supply chain for this market involves complicated processing, handling, and transportation issues, which are especially difficult for small producers to overcome. This project utilizes existing, accessible, and affordable equipment to process WSG (specifically, switchgrass) for poultry bedding, with the aim of simplifying processing and transportation logistics to increase overall operation efficiency and economic returns. In this project, we will demonstrate, characterize, and compare on-farm methods for producing and delivering a "ready" poultry bedding product from switchgrass: *Tub grinder bale grind (3 packaging variants) a.Supersack –standardized unit packaging b.Paper baler –densified, standardized unit packaging c.Garbage truck –densified, large, single-load packaging *Hammer mill bale grind *Forage harvester in-field grind (2 packaging variants) a.Supersack –standardized unit packaging b.Supersack –with FormPack higher-density packaging method *In-field custom grind Our goals are to: *Test the performance of various techniques to process, package, and deliver WSG to poultry bedding, meeting market specifications of less than 1.25±0.25 inches *Identify key advantages of each method (process in the field, eliminate baling, etc.) *Share our findings with other WSG producers to increase the use of sustainably-managed warm season grass for Northeastern poultry bedding markets The product demand and crop availability are in place, but improved logistics are needed to help this market opportunity reach its full potential.

WHAT IS THE PROBLEM AND WHY IS IT IMPORTANT?

Planting and marketing perennial warm season grass crops (switchgrass, giant miscanthus, etc.), is becoming increasingly favorable to farmers due to several sustainability-related factors, including, among others, these crops' favorable performance on marginal land, low input and maintenance requirements, and value for nutrient and soil runoff prevention. A field of warm season grass will continue to produce for 20 years or more. Unfortunately, high-value markets for warm season grasses are currently limited. However, a few key markets show immediate promise for these crops; one of these is animal bedding. Notably, chopped warm season grass has been shown in research trials to perform well in poultry houses, and the sizable demand for poultry bedding material in the region makes this a particularly compelling opportunity for farmers. Delaware, Maryland, and Pennsylvania alone produced 8.35% of the 8.545 billion head U.S. broiler total in 2014. These three states are all within the top 15 American poultry-producing states, with high demand for bedding. The poultry industry traditionally uses pine shavings as bedding, but seasonal price spikes and periodic shortages of material make alternative bedding source options (especially those with comparable or superior performance) especially attractive. Chopped warm season grass could provide the ideal alternative, either to replace traditional bedding sources or to act as an alternative supply source that hedges against market factors, insulating poultry producers from acertain amount of risk. Many farmers are familiar with the cutting and baling of grasses, but serving the bedding needs of the poultry industry presents a logistics problem to many of these farmers, for whom chopping and transporting a chopped product is not a common practice. While poultry producers could theoretically chop delivered, baled material themselves, they would much prefer a “ready to use” chopped product to simplify on-site logistics. In addition, a farmer's ability to process the product to the desired specification affords him or her the ability to market the product as value-added. Therefore, it likely falls to the warm season grass producer to process and deliver a "ready" bedding product. The best-known current practice involves baling, moving bales to an on-farm processing location, and tub grinding the grass to the desired specification. The process often presents a time-consuming logistical bottleneck in the supply chain and tends to produce a large amount of dust and debris, introducing possible respiratory and fire safety hazards to the individual who undertakes this processing step. The need for the product and availability in the field

of switchgrass is in place, but improved logistics from harvest to delivery are needed to help this market opportunity reach its full potential.

WHAT IS YOUR PROPOSED SOLUTION?

If instead, the warm season grass could be chopped at the time of harvest, dust and crop litter would remain on the field rather than accumulating at a central processing location, circumventing some of the safety hazards otherwise presented. But even after processing, moving low-density chopped bedding material to an end user is difficult for the farmer to do in a logistically and economically efficient way. Strategies are needed to improve both processing and transportation logistics. Specialized baling machinery is currently being developed and tested to accomplish in-field chopping and densification of warm season grasses, but these high-tech solutions may be too expensive for smaller-scale warm season grass producers. Lower-tech, lower-cost approaches are needed for those producers to gain footholds in a promising market. This project will utilize existing equipment that a small farmer would consider accessible and affordable to process warm season grass for poultry bedding. We will use this work to identify solutions that not only prioritize in-field chopping for the reasons outlined above, but which also eliminate the need for baling and streamline the processing logistics. This will reduce the equipment, time, and labor costs associated with the processing requirements for this market.

WHAT EFFORTS HAVE BEEN MADE BY OTHERS TO SOLVE THE PROBLEM?

Poultry bedding is a new market opportunity for growers of perennial warm season grasses, and some research has been done and is underway that explores this opportunity. Several studies have examined the performance of warm season grass as bedding, as an alternative to traditional pine shavings. For example, in the study “On-farm assessment of switchgrass bedding’ J. R. Moyle,, L. A. Brooks, B. A. McCrea and W. R. Brown studied the feasibility of using switchgrass as an alternative bedding material in commercial production houses over consecutive flocks. The use of warm season grass as bedding may have benefits over traditional sawdust bedding. J.D. Davis , J.L. Purswell , E.P. Columbus and A.S. Kiess, in their study “Evaluation of Chopped Switchgrass as a Litter Material” found that body weight, body weight gain, feed consumption, feed conversion, carcass weights and mortality were not different between switchgrass bedded poultry and traditional pine shaving-bedded poultry. However, the incidence of foot pad dermatitis was significantly decreased with switchgrass litter. In the 2016 SARE Graduate Student Grant entitled “Renewable alternative bedding for commercial broiler chicken production”, Amy Meyer of Penn State will compare willow and switchgrass bedding in a poultry house. The bedding materials will be processed at the poultry farm and not in the field. Preliminary results have demonstrated that chopped perennial grasses perform very well as bedding for poultry. Similarly, the University of Delaware Extension and the University of Maryland Extension, in collaboration with the Conservancy and Chester River Association (CRA), and Perdue poultry, conducted several field trials to study the viability of switchgrass as an alternative bedding material. These tests involved delivering baled, unchopped material to poultry farms, where it was ground at the point of use, resulting in significant dust generation and additional complexity to the already busy schedule of the poultry farmers. Commercial success of perennial grasses for bedding likely depends on the cost effective collection and delivery of pre-chopped material in a format that is easy for the poultry farmer to use, both for large poultry operations that seek to minimize labor costs, and for smaller farmers who would not be able to justify the cost of chopping equipment or the associated labor and hassle. Chopping grasses is not a new phenomenon, and there is a variety of implements and devices available on the market to carry out this task. However, chopped grasses are almost exclusively used on-site, and are generally designed for forage / animal feed systems. The unique needs for bedding production (typically a drier and smaller sized product), have yet to be studied, and guidance on this process would be invaluable for farmers looking to produce switchgrass bedding for poultry bedding. This need has not gone unnoticed, however, and a Value Added Producer Grant has just

been awarded to Ernst Seed will to explore large-scale in field preparation of perennial grasses for poultry bedding. This study will utilize high end equipment to chop and bale warm season grass for shipment. This is a valuable study and has merit for farms with large acreage able to support the use of large equipment, but this approach will not work for small plots or marginal land, which should be the focus of switchgrass production in the region. Thus, an opportunity and need exists to find lower cost, smaller scale, locally appropriate methods for producing this sustainable bedding material. This information would be a valuable tool for the development of switchgrass production in the region, leading to economic and environmental benefits for the region in the form of increased income to farmers and the positive impacts on water quality, soil quality and wildlife habitat that are associated with native perennial warm season grasses.

WHAT WILL YOUR METHODS AND MEASUREMENTS BE TO SUPPORT YOUR OBJECTIVE?

The project team has 15ac (~45 dry tons) of mature, well-established perennial warm season grass (WSG) with additional WSG available if needed. Using this acreage, four harvest/processing methods will be demonstrated, tested, and compared to determine the most cost-effective and practical means of providing chopped WSG bedding from small farms to the poultry industry. These scenarios use methods that we as producers identify as realistic, reachable options given our expertise and resources. Based on our experience, we believe these methods also present viable options for new WSG producers seeking similar market opportunities. The first two methods involve central processing for baled material and target downstream logistics innovations after this step. The second two methods eliminate central processing, prioritizing in-field processing solutions. Here, we provide examples of key measurements/attributes that will be taken/assessed during demonstration, but it is not an exhaustive list. We will work closely with the technical advisor to plan data collection/analysis. Method 1: Tub Grinder This scenario offers a current best-practice baseline reference. Tub grinding bales is currently the most commonly used practice for processing WSG into usable poultry bedding. We will cut, rake, and round bale 2ac (about 6 tons or 24 x 500-pound bales) using conventional techniques, then tub grind these bales to specifications preferred by the poultry industry (less than 1.25±0.25"). We will measure/assess: Cost and time to bale one ton of WSG. *In-field: harvesting/baling +Field/headlands dimensions –trial acreage +Fuel use (mowing, raking, baling) for all machinery +Operation time -In-field work -Headlands maneuvering -Transportation to/from site -Stoppage for repairs, OSHA-mandated operator breaks if applicable, etc. +Bale metrics: weight, moisture, dimensions Cost and time to tub grind one ton of WSG. *In-field: transporting bales, field to processing site +In-field bale distribution +Fuel use for all machinery +Operation time -Active work of bale-moving machinery (skid steer) -Transportation to/from site -Stoppage *Processing site: tub grinding +Fuel use for all machinery (skid steer, tub grinder) +Operation time -Active work, run time loading/processing bales (tub grinder, skid steer) -Stoppage Three delivery methods will be tested for tub-grinder material output. Method 1a: Tub Grinder–Supersack We will load tub-ground material into supersacks and assess the practicality of loading, delivering, and emptying a supersack full of tub-ground WSG. We will measure/assess: *Filled supersack dimensions, weight, moisture, ease of handling *How many supersacks and what total tonnage could be delivered in a semi *How easily supersack contents can be placed and emptied Method 1b:Tub Grinder–Paper Baler We will attempt to bale tub-ground material with a shredded paper baler and learn whether a paper baler can be used to densify/compress already-chopped WSG into a deliverable bale. We will measure/assess: *Compressed bale dimensions, weight, moisture, ease of handling *How many compressed bales and what total tonnage could be delivered in a semi *How easily compressed bale contents can be placed and emptied Method 1c:Tub Grinder–Garbage Truck Lastly, we will rent a garbage truck and load tub-ground and/or custom-ground (see method 4) WSG into the truck, using the truck's compression mechanics to compress material as we load. A garbage truck, with its ability to compress loose material, can be packed more densely with pre-chopped WSG for delivery, improving logistic and

cost efficiency. We will assess load capacity, viability of this compression method for ground material, and ease of unloading compressed WSG delivered this way. We will measure/assess: *Tare and filled weight of the garbage truck *Garbage truck capacity (volume) -to determine load density *How easily garbage truck contents can be unloaded and handled. Method 2:Hammer Mill We know a hammer mill can process WSG to desired specifications but wish to assess this method's advantages/disadvantages compared to the conventional tub grinder approach. We will hammer mill 2 tons or 8 bales, then load material into supersacks. We will measure/assess: *Cost and time to hammer mill one ton of WSG *Loading ease of hammer milled material into supersacks *Filled supersack dimensions, weight, moisture, handling ease *How many supersacks and what total tonnage of hammer milled material could be delivered in a semi *How easily supersack contents of hammer milled material can be placed and emptied. Method 3:Forage Harvester and Wagon We will forage cut 4ac (12 tons) into a forage wagon; by adding knives to the forage cutter chamber we hope to achieve material cut to less then 1.25±0.25" as specified by poultry bedding standards, which will be loaded into 60 supersacks. Using FormPack equipment,we will attempt to increase the density of material in the supersack, reducing shipping costs. We will measure/assess: *Cost and time to forage cut one ton of WSG (ton-to-acre calculation will be based on baling assessment measurements). +Field/headlands dimensions–trial acreage +Fuel use for all machinery +Operation time -Active work:forage harvester,wagons -Machinery transportation to/from site -Stoppage *Ease of loading forage cut material into supersacks *For both Supersack–standard packing and supersack–FormPack increased-density packing +Filled supersack dimensions, weight, moisture, handling ease +How many supersacks and what total tonnage of forage-cut material could be delivered in a semi +How easily supersack contents of forage cut material can be placed and emptied. Method 4:In-field Custom Grind At the McDonnell farm, we will cut and custom grind 8ac (about 24 tons) in the field using a mobile grinder machine. The ground material will be loaded in supersacks. We also want to gain familiarity with the equipment used for this method. We will measure/assess: *Cost and time to prepare the material for grinding (mowing and raking measurements will come from baseline scenario assessment). *Cost and time to grind one ton of material using this method (ton-to-acre calculation will be based on baling assessment measurements). +Field/headlands dimensions–trial acreage +Fuel use for all machinery (if not incorporated in custom rate) +Operation time -Active work of grinding machinery, wagons -Stoppage

WHAT IS THE TIMETABLE OF YOUR PROJECT?

Warm Season Grass can be harvested in the early Spring. When it stays in the field over Winter, it contains the least amount of moisture and is most ideal for poultry bedding. It usually has a moisture content between 8 and 12 percent. The primary disadvantage to this is you are subject to weather conditions that prevent you from entering the field. Therefore, I am not able to specifically state a month and day when things will occur. March/April 2017 - Arrange final agreements for equipment not available at Wood Crest Farm. Move equipment to Wood Crest from Hartpence Farm and Reggie Farm. Prepare areas for supersack storage so material is out of the weather. Plan for material transfer from one piece of equipment to supersack storage. Perform preventative maintenance on all equipment. Based on ground and weather conditions the following tasks will be completed during the months of April, or May. The exact dates being determined by the weather. The days will not necessarily be consecutive. Day 1 - cut 11 acres with a flail chopper - collect all associated data, take pictures and video Day 2 - rake the 11 acres for baling and grinding - collect all associated data, take pictures and video Day 3 - round bale 3 acres (about 9 tons) for 36 bales - collect all associated data, take pictures and video Day 4 - grind 8 acres with mobile grinder and load supersacks - collect all associated data, take pictures and video Day 5 - forage cut the remaining 4 acres and load into supersacks - collect all associated data, take pictures and video Day 6 - move 8 bales from Wood Crest Farm to Reggie Farm for hammer mill processing - collect all associated data, take pictures and video Day 7 - move bales from Wood Crest Farm to Hartpence Farm for tub grinding and additional processing - collect all associated data, take pictures and video Day 8 - Hammer Mill

material at Reggie Farm and load into supersacks - collect all associated data, take pictures and video Day 9 - Tub grind material at Hartpence Farm and load some into supersacks - collect all associated data, take pictures and video Bale the remaining tub ground material using the paper baler - collect all associated data, take pictures and video. Handle the bales with loader equipment to determine durability of the bale. - collect all associated data, take pictures and video Outreach dissemination of data will follow Day 1 activities and continue through Day 8. Pictures and comments will be posted directly from the field to the Association FaceBook page. Additional information will follow to PSU sources and NewBio outlets on a regular basis. Data analysis and report generation will occur from June 2016 through January 2018. The final Report will publish in February 2018. The Field Day / Workshop will take place in March 2018.

WHAT IS THE OUTREACH PLAN?

In addition to formal data collection, project members and the technical adviser will, while engaged in demonstrations, assume responsibility for taking photographs, relating or recording anecdotal/informal documentation/information about their experiences. These materials will be used to produce ongoing project updates shared with the public via online platforms including social media, blogs,newsletters, etc. managed by Penn State Extension, the NEWBio Consortium, the Association of Warm-Season Grass Producers, and other affiliated stakeholders. Progress and findings will also be integrated into face-to-face engagement undertaken by these partners, including presentations, field days, exhibits, etc. that target audiences interested in warm season grass management, processing, and marketing. Together, activities on these platforms reach thousands and broaden recognition of the issues this grant highlights and takes on. As with other SARE grants involving regular outreach, the overall impact of these activities will be wider than we can easily predict. At the conclusion of the project, we will work with Penn State Extension, specifically our technical adviser, to complete two formal outreach pieces: 1.We will author a report of our findings from this project that can serve as a recorded reference. It will be made available for public download via the AWSGP website (www.awsgp.org), but it will also be distributed and shared by our affiliated stakeholders. 2.In partnership with Penn State Extension, we will host a public short course/seminar/field day/workshop where we will present our findings to interested stakeholders (especially warm season grass producers, the poultry industry, agricultural-sector small business development entities, etc.)

WHAT IS YOUR FARM BUSINESS AND HOW WILL YOUR PROJECT FIT IN WITH YOUR FARM OPERATION?

Farmer - Will Brandau - Wood Crest Farm -Wood Crest Farm is a 140 acre farm on the banks of the Susquehanna River. I have farmed it part time for 10 years. It was planted with warm season grass about 10 years ago. 40 acres was used. The rest of the farm is forest. A portion of the grass is harvested for fuel. It is burned either as pellets or as large square bales. The pellets are produced on the farm with a small pellet mill. The large square bales are shipped to a greenhouse where they are burned in a specially designed boiler. A very small portion is sold as mulch. Not all of the grass produced is used. Processing bedding for poultry houses will expand the available market for Wood Crest Farm as well as other warm season grass farmers. Gross sales last year was about $9000. 15 acres of warm season grass will be dedicated to this project. Farmer - Leonard Reggie- Leonard is a mechanical engineer with a full metal fabrication shop. He will provide consulting expertise and equipment adaptation where needed. Farmer - Larry Hartpence- Larry owns a paper shredding business, All Shred. He has extensive experience grinding and baling shredded paper. He will provide consulting expertise, tub grinding equipment and paper baling equipment. He also owns trucks, trailers and loaders which he will provide to test loading and delivery efficiency. Farmer - Frank McDonnell - Frank has a mobile grain grinder unit with multiple screens. We will use it as a method to process the grass. Supporting Business Mike Owens - FormPak Inc. FormPak specializes in loading supersack bags. Mike has agreed to use their research and development department to

look for a way to densify the material in a supersack.

Budget

Category	Line Item Description	Amount
Personnel	Farmer compensation	$1,800
Materials and Supplies	Purchase supersacks	$1,600
Travel	Travel to farms, move equipment, move material	$3,165
Printing and Publications	Final report	$180
Other Direct Costs	Workshop, equip. rental, subcontractor help	$6,810
Indirect Costs	None	$0
Total Request		**$13,555**