2013 NJ Conservation Innovation Grant
Grant # 69-2B29-13-201
BETWEEN THE
UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
AND
JAMES LAINE, LAINE FARMS

PROJECT: Use of Specialty Commodity Crop as Alternative Vegetation Type on Land Being Taken Out of and/or Considered for Biofuel Crops to Aid and Maximize Habitat Value for Grassland Dependent Bird Species
Project Timeframe Covering: Sept. 2013 to Sept. 2016

FINAL REPORT

Prepared by James Laine (Laine Farms) & John Parke (NJ Audubon)

Executive Summary

Over the last several years, NJ has seen many warm season grass (WSG) fields that were installed under various State and Federal conservation programs being removed and converted back to main stay commodity crops with more established markets, specifically corn and soybeans. The conversations were mainly due to rising prices of these commodity crops combined with a lack of an established biofuel market for the warm season grass in New Jersey. With the removal of these grass fields in favor of more traditional commodity crops, grassland dependent birds (which make up 41% of all threatened and endangered species in NJ[1]) continue to experience significant habitat loss. As part of this grant, the producer, Laine Farms, worked with the New Jersey Audubon (NJA), to demonstrate the use of a specialty commodity crop, spelt (*Triticum aestivum* subsp. *Spelta*), as a possible alternative vegetation type on land being taken out of, and/or considered for biofuel crops (warm season grass) to aid and maximize habitat value for grassland dependent bird species while also providing a producer with an economically viable commodity crop.

Spelt is similar in structure and growing-season to the typical native warm-season grasses (WSG) used for biofuel. Like WSG, spelt is typically harvested AFTER July 15 in the northeast region of the United States. Harvesting after this date will not impact the breeding bird months, unlike the harvesting of cool-season grass hay crops or other grain crops such as rye, oats, barley or wheat. Although spelt is structurally similar to that of WSG, a key component of field use by grassland dependent birds is the amount of bare ground between the grasses. Many grassland bird species such as Vesper Sparrow and Horned Lark, for example, require patches of bare ground for nesting and feeding[2].

[1] http://www.nj.gov/dep/fgw/tandespp.htm
[2] Jones, A., Vickery, P., 1997, *Conserving Grassland Birds*, Grassland Conservation Program, Center for Biological Conservation, Massachusetts Audubon Society

The objective of the project specifically looked at seeding rates for spelt which was thought to possibly effect the density and structure of the overall field by creating "bare patches" that could help maximize breeding/foraging habitat value and provide for target species (target species refer to the rare New Jersey State listed grassland dependent bird species, such as the Grasshopper Sparrow, Bobolink, Savannah Sparrow, American Kestrel, Vesper Sparrow, Horned Lark and Eastern Meadowlark). Specifically, lower seeding rates would theoretically provide less dense stands of vegetation and barer ground and opportunity for other forbs to grow. Seeding rates were also evaluated from a producer perspective specifically assessing yield and if by adjusting seeding rates would it be an economically viable alternative crop for a producer to consider in their rotation.

Given the limited timeframe (3 years) of the grant period one must consider that all data collection for this project should be considered "preliminary" at best. In order to make definitive statements regarding bird usage of the spelt fields, as well as, comprehensive analysis of costs/income for production/income on the crops mentioned in this study, long term studies are more appropriate. This is due to a significant number of variables that can affect the study each year, including but not limited to, fluctuating energy and crop production costs (global market), fluctuating supply and demand (consumer markets), fluctuating weather and vegetation patterns effects on breeding birds and crop production. Additionally, since the study was limited to just 3-years, it was determined that point count survey methodology would be used as bird survey monitoring protocol for this study. Given that most of the target species are threatened or endangered in New Jersey, the point count survey was less intrusive to birds in the field and would provide the maximum amount of data collection for diversity and abundance of species in the fields. Therefore, no nest searching or detailed territory mapping was performed.

Despite the above mentioned limitations, results indicated that several target grassland dependent bird species were observed in the spelt fields each year of the study, as well as several species of scrub/shrub species, several of which were State Listed Species of Special Concern[3]. Additionally, results indicated that lower seeding rates of the spelt did not seem to affect use by the birds, but rather the spelt fields approximation to other crops. Specifically, when spelt fields were adjacent to other graminoid (grass or grass-like) species fields (i.e. cool season grass, wheat, barley, etc.) more species were observed using the spelt field, rather than when spelt fields were adjacent to traditional "row crop" fields such as corn or soybean. This observation suggests that bird use of the spelt fields was more associated with habitat patch size rather than the composition or structure of the field. Contemporary research shows that many species of grassland birds require large blocks of habitat, avoid edges, or do not nest successfully near edges.

However, since the spelt fields were located within an agricultural matrix of hay fields and other agricultural crops; it could not be confirmed whether these species observed were specifically breeding in the spelt. Although males were noted signing on territory in the spelt fields during the breeding season, breeding could not be confirmed. Nevertheless the mere fact that target bird species specific to grassland or other early

[3] The term "Species of Special Concern" applies to species that warrant special attention because of some evidence of decline, inherent vulnerability to environmental deterioration, or habitat modification that would result in their becoming a Threatened species. This category would also be applied to species that meet the foregoing criteria and for which there is little understanding of their current population status in the state. http://www.state.nj.us/dep/fgw/spclspp.htm

successional type habitat were observed in the fields throughout the breeding season consistently over each year of the study is a positive indicator that spelt may be a suitable surrogate to the more preferred WSG in cases where farmers are not willing to sacrifice land for WSG installation either for production (harvest) and/or establishment under certain federal programs strictly for conservation purposes (non-harvest).

Additionally, production cost/income of spelt when compared to the production cost/income of warm season grass was found to be a much better option for a producer as far as diversifying their crops, because of spelt's use in the current consumer market. Spelt has a current market established as both an animal feed and grain for human consumption. Additionally, unlike WSG; spelt can be planted with conventional farm equipment so costs pertaining to obtaining specialized planting or harvesting equipment and the maintenance of that equipment are not applicable. Furthermore, unlike WSG crops planted under current USDA programs, entire fields of spelt can be harvested while still leaving enough structure on the fields for winter bird cover. Also unlike WSG, spelt does not have to wait years for establishment in order to be harvested, thus making it a more of an economic attractant to producers considering diversifying crops in both the short and long term.

I) Purpose of Project

The purpose of this project was to demonstrate the use of a specialty commodity crop, spelt (*Triticum aestivum* subsp. *Spelta*), as a possible alternative vegetation type on land being taken out of, and/or considered for biofuel crops (warm season grass) to aid and maximize habitat value for grassland dependent bird species while also providing a producer with an economically viable commodity crop.

This project was completed under the authority of the Environmental Quality Incentives Program (16 U.S.C. Section 3839aa-8) under section 1240H of the Food Security Act of 1985, as amended by section 2301 of the Farm Security and Rural Investment Act of 2002 (Public Law 107-171) and section 2509 of the Food, Conservation, and Energy Act of 2008 (Public Law 110-246).

II) Project Background

Over the past decade Laine Farms and New Jersey Audubon have been leaders in promoting the use of native warm-season grasses (WSG) on land for the dual purpose of biofuel crop production and critical habitat for grassland dependent birds. In fact, in 2008, Laine Farms was awarded a Conservation Innovation Grant (CIG) for this exact purpose (Grant # 69-2B29-8-115).

Unfortunately, the results of that study were not promising given the current affordable technology available to the average person/producer to both process and utilize the WSG crop. Specially, this technology was not efficient enough to consider the use of biofuel crops as an economically viable crop for a typical New Jersey producer when there is literality no market for the material as a biofuel in New Jersey. Additionally, it was also determined the WGS pellets themselves do appear to have applicable commercial value, based on their BTU output and production cost vs. that of production of typical fossil fuels. However, until the small scale heating appliance technology is improved to better handle

burning grass pellets and consumers embrace the concept and demand improves, it was the opinion of Laine Farms that pelletizing the grass for biofuel use may not be a viable commodity crop for the New Jersey farmer at this time.

Given the lack of demand for biofuel crops in NJ, coupled with the price of corn and other commodity crops rising over the years, as well as land values, the rates paid by the government under conservation programs to plant WSG have been unable to keep up. Furthermore, a slowdown of enrollment into conservation programs associated with planting WSG has also occurred in NJ. Many contracted acres of established fields of native warm-season grasses under previous conservation programs, (particularly the Landowner Incentive Program), are being pulled out in favor of planting commodity crops with established markets, such as corn and soybeans.

This is not just a trend in NJ, but a nationwide trend. According to the US Department of Agriculture, "the overall amount of land enrolled in the Agriculture Department's Conservation Reserve Program has dipped to 29.5 million acres from a peak of 36.7 million in 2007"[4].

Additionally, several other deterring factors play into a planning and decision aid for a producer considering a WSG biofuel crop on the land in NJ. Specifically:

- the disbandment of a few key governmental funded incentive and cost-share programs that promoted WSG planting and its use,
- the harvest restrictions on WSG associated with remaining government programs (i.e. CREP, SAFE, CRP);
- the fact that the WSG takes approximately 2-3 years to establish a field, (thus the producer cannot harvest a crop off these fields for that period of time);
- there is no approved large scale receiving facilities in NJ to efficiently process the WSG material for biofuel;
- large scale heating units capable of utilizing the process WSG material efficiently are very expensive and require expensive air permitting fees and testing by State environmental agencies,
- and the relatively small landbase that is available to producers in NJ whereby unless there is existing market demand or a compatible and/or above market rate price for biofuel crops it does not make economic sense to a producer to plant biofuel crops on their land and lose their agriculture commodity crop "Base[5]" on the land by planting said grasses.

Based on the information listed above, it may be unreasonable to recommend the use of WSG biofuel crops on production agriculture land in NJ at this time. Furthermore, based on personal interaction with producers compiled over the past decade, approaches by various non-governmental organizations and/or conservation groups to promote the use of the WSG without an understanding of the current regional market demand and restrictions of harvesting the materials under current conservation programs may also be putting a producer at risk to lose land and/or take such a loss that the producer considers selling off the farmland for a non-agricultural use that ultimately provides no natural resource, social or environmental benefits.

[4] http://www.nytimes.com/2013/01/01/us/as-pheasants-disappear-hunters-in-iowa-follow.html?_r=0

[5] "Base acres" means, with respect to a covered commodity on a farm, the number of acres of the crop established by the election of the owner or owners of the farm. Hay is not eligible for base and establishment of grass on former commodity crop land removes that base from that land in grass.

Figure 1: Field of native warm-season grass species - Morris County, NJ

This lack of demand for biofuel crops in NJ has seen many producers, particularly in the northern portion of the state, are now shying away from establishing new fields and are pulling out established fields of native warm-season grasses (WSG) in favor of commodity crops with more established markets, such as corn and soybeans.

Unfortunately, with the loss of large fields of agricultural WSG grasslands and the lack of interest to install new ones, wildlife dependent upon this habitat type inevitably will be impacted. Grasslands in the eastern United States rank as one of the country's 21 most endangered ecosystems[6]. New Jersey's remaining grasslands are almost entirely embedded within agricultural landscapes and grassland dependent birds make up 41 percent of the state's endangered bird species, 29 percent of its threatened birds, and 16 percent of its birds listed as special concern.

Because of these landscape changes, many grassland birds are increasingly dependent on the agricultural community for habitat creation, maintenance, and health. However, given NJ's relatively small available land base and associated farm size (79 acres is average farm size in NJ[7]) compared to that of other states to potentially create native grasslands, alternative vegetation types that could serve as viable substitutes for grassland habitat types on farms that have economic value to NJ producers need to be evaluated. This becomes especially important to a producer and/or land managers that are considering removing existing native grass fields in favor of commodity crops or are considering diversifying farm production via biofuel stock production.

Figure 2: Spelt Field in Somerset County, NJ

By having an alternative, a producer can be supplied with options for a better long-term plan for his land that has consideration to accommodate both the producer's economic concerns and can maximize habitat value for wildlife. At this point in time the need must be addressed from a different perspective.

Specifically, a move away from the initial thinking that WSG biofuel crops, are the only crops that will provide the dual benefit of providing a producer with economic diversity/stability in their operations and the critical habitat needed for grassland dependent birds.

---

[6] Noss, R., Peters, P., 1995, Endangered Ecosystems: A Status Report on America's Vanishing Habitat and Wildlife., Defenders of Wildlife, Washington D.C.

[7] http://www.nj.gov/agriculture/news/press/2014/approved/press140224.html

Coming from a different perspective, and based on producer commentary over the last few years, Laine Farms and NJA worked with Spelt (*Triticum aestivum* subsp. *Spelta*) as an alternative crop. Specifically, this crop would not sacrifice food production for habitat value, and could be seen the possible solution to this dilemma.

Spelt, a sub-species of common wheat, has been grown in Europe for about 300 years and was introduced to the United States in the 1890s. In the early 1900's there was up to 500,000 acres grown in the USA. However, with the development of the combine, spelt, requiring an extra step to remove the hulls, was replaced by uncovered wheat in many areas by the 1920s. In recent years, spelt has reemerged as a viable product and a major cash crop, especially for organic and artisanal small grain growers in the health food market, both in the USA and in Europe. It is reported to be much easier to digest than wheat and its nutrients are more "bioavailable," that is, more readily accessed during digestion. (Janzen)[8]

Additionally, spelt is similar in physical structure and growing-season to the typical native warm-season grasses used for biofuel and can conceivably accommodate the needs of breeding upland grassland dependent birds.

III) Grant Deliverables

The anticipated results for this project were ecological benefits specifically for grassland dependent bird species. The project also spotlights a unique opportunity for farmers by adding an alternative crop market to the region that in turn could help strengthen farm income, all the while aiding in restoring and managing critical wildlife habitat and potentially having additional revenue entering into the rural community through a new market. To hopefully obtain these expected results the following items were listed by NRCS as the project deliverables:

- Analysis of spelt seeding rates to create suitable habitat for grassland dependent bird species, targeting current NJ State Listed species.

- Analysis of production cost/income of spelt as an alternate crop to production cost/income of native warm season grasses (WSG) that are used for biofuel.

- Identification of spelt market options in NJ and evaluation of spelt yield based on specific seeding rates used to maximize habitat potential for grassland dependent birds.

- Evaluation of grassland bird habitat (presence/abundance surveys) associated with spelt fields compared to native WSG fields.

- Provide NRCS and/or other partner training (if applicable) in the use of the practice as a potential alternative when doing conservation planning for grassland dependent birds (provided study results indicate as such). Provide project promotion and outreach to engage other producers through project fact sheet preparation (if applicable), data dissemination on NJ Audubon website and through NJ Audubon

[8] http://www.agmrc.org/media/cms/SpeltStory_0E4AE35188557.pdf

organized meetings at/with agriculture and/or wildlife related venues/organizations as follows:

a) NJ Audubon on behalf of Laine Farms will provide project information on its website and magazine, as well as contact media outlets such as local papers farming periodicals such as New Jersey Farmer to promote the intent of the project and provide background information.

b) NJ Audubon will present updated project information regarding results/progress at one USDA-NRCS field office staff training or one USDA-NRCS State Technical Committee meeting, the venue (office or field) to be determined at the time of the outreach.

c) Should project data indicate results which address the resource concern to the satisfaction of the grantee and NRCS, NJ Audubon on behalf of Laine farms will then provide, the following:
   - 1 factsheet covering the background, issue, process, project results and technology transfer to NRCS program and technical standards.
   - 1 USDA-NRCS State Technical Committee Meeting
   - 1 Workshop/town hall type meeting for agricultural producers as well as other invited entities
   - Media outreach (local newspapers, New Jersey Farmer NJ Audubon website, etc.).

- Final Project Report.

III.A) Analysis of spelt seeding rates to create suitable habitat for grassland dependent bird species, targeting current NJ State Listed species.

From a wildlife resource perspective, spelt is similar in structure to many of the native warm-season grasses (WSG) promoted for biofuel use and more importantly spelt is typically harvested AFTER July 15. This harvest time will not impact the critical breeding bird months (April – Mid July); unlike the harvesting of cool-season grass hay crops or other grain crops such as rye, oats, barley or wheat. In 2012 Laine Farms and NJ Audubon had performed a trial planting of spelt at the South Branch Wildlife Management Area in Somerset County, NJ and had promising results with breeding grassland birds. Specifically, two 15-acre trial field plots of spelt were planted at the seed supplier recommended seeding rate of 120-lbs/acre for maximum yield results[9].

Figure 3: Male Indigo Bunting sinning on territory in Spelt field 2014 Somerset County, NJ

Fields were monitored during the breeding season and results indicated several grassland dependent bird species, including field sparrow, indigo bunting, red-wing blackbird utilizing the fields for breeding purposes, as well as American kestrel and Blue Grosbeak using the area to forage.

[9] Note: if the goal is for forage then the recommended seeding rate is increased to 150 lb/Acre.

Based on the results of the trial study in 2012, NJ Audubon had postulated that a possible reason for the lack of use by State listed species (Grasshopper Sparrow, Horned Lark, etc.) of the spelt fields was possibly due to a high seeding rate of the planted crop thereby not providing enough bare ground patches in the field which are a staple commodity for use of a field by grassland dependent birds.

NRCS and other federal wildlife agencies publications on native WSG establishment recommend seeding rates for WSG when considering grassland birds between 8 to 10-lbs per acre, given that WSG is "clump" forming and by nature will produce patches of bare ground between the clumps.

Based on this information the project incorporated a series of 15-acre fields planted with spelt at different reduced seeding rates. Specifically, 80, 100 and 120-lbs/acre. By altering seeding rates, it was thought that the stands would be less dense and create the patches of bare ground seen in typical warm-season grass fields for suitable nesting and feeding, thus attracting a more diverse suite of grassland species (State listed species).

All spelt fields utilized during the 3-year grant period were located either on the home farm of Laine Farms or on lands farmed by Laine Farms, specifically, in the South Branch Wildlife Management Area - Merck Tract in Somerset/Hunterdon Counties. These fields were chosen primarily because the grant recipient had previously been farming these tracts for years and was intimately familiar with the land (soils, nutrient supplementation, etc.). Additionally, control fields of native warm season grass were also located at these locations.

Also note that all spelt experimental fields, except for spelt control fields, were planted adjacent to woodland or cultivated fields containing soybean or corn. Spelt control fields planted at 120-lbs/acre but planted adjacent to other grass or "grass-like' crops (cool season grasses, barley, wheat, oats) were also monitored to evaluate if bird use was related to the field placement in the landscape (patch-size[10]). These spelt control fields were slightly less in size (typically 8 acres), but by being surrounded by other seemingly suitable habitat appeared to be larger than 15 acres.

To measure vegetation cover[11] (plant abundance) in each spelt field the visual estimation method was used. Specifically, a 1 m^2 (10.7 sq. foot) quadrat PVC frame was constructed in the field during field visits in mid late May (i.e. the mid-way point of bird nesting season). Each quadrat was chosen at random. A visual estimate of the percentage of cover in quadrat area beneath the vegetation for each was collected. Plants rooted outside the quadrat were also included in cover measurements to the extent that their leaves projects into the quadrat space[12]. Relative Density was then determined by dividing species density (spelt) by total density for all species (spelt + other herbaceous species) x 100.

<u>Relative Density of Cover in the Spelt Fields:</u>
(lbs. refers to the spelt seeding rate for the specific field)

[10] Patch-size refers to the minimum size of a contiguous grassland habitat that a bird species needs to thrive and reproduce.
[11] Cover is the proportion of the ground obscured by a species' aboveground leaves and stems and flowers.
[12] Barbour, M.G., J.H. Burk, and W.D. Pitts. Terrestrial Plant Ecology. Chapter 9: Method of sampling the plant community. Menlo Park, CA: Benjamin/Cummings Publishing Co.; 1987

2014

Field #1 (120 lbs.) – RD = 95.5%

Field #2 (100 lbs.) – RD = 86.89%

Field #3 (80 lbs.) – RD = 91.37%

2015

Field #1 (80 lbs.) – RD = 85.7%

Field #2 (100 lbs.) – RD = 89%

Field #3 (120 lbs.) – RD = 64.28%*

*Note: crop failure - many weed species and bare areas

2016

Field #1 (80 lbs.) – RD = 87.42%

Field #2 (100 lbs.) – RD = 88.50%

Field #3 (120 lbs.) – RD = 95.65%

Figure 4: Example of Typical Cover in Spelt Field Somerset County (2015)

Although some bare areas were noted in areas with lower seeding rates, forbs and other "weed" grasses were observed to be more frequent in these areas, thus filling in most of

rows between the spelt plants which accounted for the higher percentages in vegetation cover in the fields. Bird use of the fields in relation to the seeding rates are as follows:

III.A.1) 2014 Survey Results based on Seeding Rates

After reviewing data collected from the bird surveys in year one of the study, one target grassland dependent bird species, specifically Grasshopper Sparrow (a NJ Threatened species – breeding population) was noted in all three of the experimental area spelt fields. Grasshopper Sparrow was not detected in the spelt control field, but was detected in 2 of the 3 native warm-season grass control fields.

Figure 5: Grasshopper Sparrow

Other birds (non-target species) that do use grasslands for breeding were also recorded in all three experimental spelt fields. These non-target species included Indigo Bunting, Field Sparrow, and Red-wing Blackbird.

In 2014, spelt treatment area #3 that was seeded at the lowest seeding rate (80 lbs./acre) had the most species diversity detected of all the spelt treatment areas (5 species, including Eastern Towhee). The spelt control area planted at the highest seeding rate (120 lbs./acre) had three (3) non-target species detected and no target species. The native grassland control points had the highest number of target grassland species, (5 individual target species including American Kestrel, Bobolink, Eastern Meadowlark, Grasshopper Sparrow, and Savannah Sparrow); as well as the highest non-target individual species, (7 species including Blue-winged Warbler, Brown Thrasher, Eastern Bluebird, Eastern Towhee, Field Sparrow, Indigo Bunting, and Red-Wing Blackbird.)

III.A.2) 2015 Survey Results based on Seeding Rates

In 2015, American Kestrel was the only grassland bird species observed using the all three experimental spelt fields. However, Bobolink, Eastern Meadowlark, and Grasshopper Sparrow were observed at Spelt Field#3 which was less dense than any of the other spelt points, with a large percentage of bare ground with "weed" grasses (foxtail) and forbs mixed in. Although Spelt Field #3 was less dense than the other two fields, the field had been planted at the standard 120-lbs/acre seeding rate. The 2015 season experienced severe drought conditions which may account for change in vegetation structure (height) and weed growth in this field and therefore could be associated with the use or non-use of the spelt fields by the target species. Note: Spelt Field #3 ultimately could not be harvested because of crop failure.

Bobolink, Eastern Meadowlark, and Grasshopper Sparrow were also observed in the grassland control points in 2015 as well as, one of the spelt control fields that was surrounded by other cropland (barley) and cool-season hay fields that had not be impacted by severe drought conditions.

Additionally, a variety of scrub/shrub species were also observed using the spelt fields and surrounding edge habitats including Eastern Bluebird, Eastern Towhee, Field Sparrow, Indigo Bunting, Red-winged Blackbird and Blue Grosbeak.

III.A.3) 2016 Survey Results based on Seeding Rates

The 2016 breeding season indicated several grassland species, Indigo Bunting, Field Sparrow and Red-wing Blackbird, utilizing all spelt treatment fields. However, the spelt field planted at standard seeding rate (120 lbs./acre) was found to have the only observation of a target grassland species, Grasshopper Sparrow.

During the 2016 survey period, the Spelt Control field (planted at 120-lbs/acre) was observed to contain four target species; (Bobolink, Eastern Meadowlark, Grasshopper Sparrow, and Savannah Sparrow). This spelt field was surrounded by other cropland (barley) and cool-season hay fields.

Results of the survey of this second spelt field indicated four target species; (Bobolink, Eastern Meadowlark, Grasshopper Sparrow, and Savannah Sparrow).

III.A.4) Discussion

Based on these preliminary results over the 3-year study, it appears that lowering seeding rates for spelt did provide variation in density of the stands and thereby provided patches of bare ground and allowed for more forb growth between the rows. However, overall bird use of the spelt fields by grassland species, anecdotally, appeared to be more rooted in placement of the spelt field in the landscape in approximation to other crops.

Specifically, when spelt fields were adjacent to other graminoid (grass or grass-like) species fields (i.e. cool season grass, wheat, barley, etc.) more species were observed, rather than when spelt fields were adjacent to traditional "row crop" fields such as corn or soybean. This observation suggests that bird use of the spelt fields was more associated with habitat patch size rather than the composition or structure of the field. Contemporary research shows that many species of grassland birds require large blocks of habitat, avoid edges, or do not nest successfully near edges.[13]

Figure 6: Spelt field planted next to a corn field (L), Spelt Field Planted next to grassed waterway (R) Both in Somerset County, NJ

[13] Herkert, J., Szafoni, R., Kleen, V., Schwegman, J., Habitat Establishment, Enhancement and management of Forest and Grassland Birds in Illinois, 1993, Natural Heritage Technical Publication #1.

III.B) Analysis of production cost/income of spelt, as an alternate crop to production cost/income of native warm season grasses (WSG) that are used for biofuel

The location of the milling facility discussed in this grant is the Laine Farm located in Hillsborough, Somerset County, which had been already operating as a small feed mill operation using grain. However, since the spelt harvested through this grant was ONLY used for livestock feed, the grain was NOT de-hulled. Therefore, costs for de-hulling and/or associated grain transportation costs to a mill equipped to de-hull the grain for human consumption are not provided herein.

This milling operation and its producer have been in operation for 30 years and were therefore well versed and experienced in milling operations, the equipment involved and its operation. Additionally, through a previous CIG grant through NRCS associated with WSG and biofuel production at Laine Farms, equipment specific for pelletizing WSG was also readily available on site prior to the implementation of the Spelt project. Therefore, all costs related to the purchase of related milling equipment necessary for both planting and production of spelt and/or pelletizing WSG for biofuel are not included in this analysis since costs can vary greatly year to year, due to brand name, workmanship, and technology advancements.

However, a listing of equipment that is on site specific for pelletizing WSG for biofuel that the producer considering WSG as a crop for on-site biofuel production is as follows:

- 15 hp diesel pellet mill
- 30 hp electric pellet mill
- Tub grinder
- Belt conveyor
- Variable speed controller
- Mixer
- Phase converter

III.B.1) WSG Production for Biofuel

General costs associated with WSG production as biofuel crop (in pellet form) as experienced by Laine Farms planting a 15-acre field on a per acre cost is follows:

WSG Crop

Planting	Acres/hr	$/hr	$/acre
Spray Roundup	15	$26	$1.73
Planting w/10'Drill	5	$26	$5.20
Spring Weed Control	15	$26	$1.73
		Sub-total	**$8.67**

Planting Inputs	$/unit	Units/acre	$/acre
Seed	$9.50/lb	10	$95.00
Roundup	$0.1298 / oz	24	$3.11
2-4D	$3.1563 / pt	1.5	$4.73

Fert. Liq. N	$0.1540 / lb	150	$23.10
		Sub-total	**$125.95**

Harvesting	Acres/hr	$/hr	$/acre
Cutting	7	$26	$3.71
Tedding	10	$26	$2.60
Raking	8	$26	$3.25
Bailing (round bale)	5.625	$26	$4.62
Handling			$20.00
Fuel			$5.84
		Sub-total	**$40.02**

Pellet production	$/hr	$/acre
Grinding (fuel)		$21.40
Labor (grinding, pelletizing, bagging)	$26/ 8 hr	$208
Electric Mill		$11.52
Electric other		$6.00
	Sub-total	**$246.92**

TOTAL = $421.56

Based on the information above it was Laine's Farms experience that the total cost per acre of planting, harvesting and pelletizing WSG for the purpose of biofuel (pellet form) was a total of $421.56/acre.

Value

Note: Wood Pellets prices range from $239.00 to $299.00 (avg $269.00)
Per acre value: 2 tons/acre, price $269, $/acre =$538.00

Profit/Loss $538.00
-$421.56
$116.44

III.B.2) Spelt Production

General costs associated with spelt production as experienced by Laine Farms planting a 15-acre field on a per acre cost is follows:

Spelt @ 100 lbs/acre

Planting	Acres/hr	$/hr	$/acre
Residue Management	8	$26	$3.25
Spray Roundup	15	$26	$1.73
Planting with 10' Drill	5	$26	$5.20
Spring Weed Control	15	$26	$1.73

		Sub-total	**$11.92**

Planting Inputs	$/unit	Units/acre	$/acre
Seed	$0.6750/lb	100	$67.50
Roundup	$0.1298 / oz	24	$3.11
2-4D	$3.1563 / pt	1.5	$4.73
Fert. Liq. N	$0.1540 / lb	150	$23.10
Fuel	$2.1400 / gal		4.90
		Sub-total	**$125.95**

Harvesting	Acres/hr	$/hr	$/acre
Custom Hire			$35.00
Trucking (fuel)			$0.5350
Trucking (labor)			$39.00
		Sub-total	**$74.54**

	Acres/hr	$/hr	$/acre
Bailing (labor)		80	$8.32
Fuel @ 5-gall/hr ($2.14 / gal)			$3.4240
Handling @ $50.00 / wagon load			$30.77
		Sub-total	**$42.51**

Total: $201.38 for 120 lb seeding rate
$232.32 for 100 lb seeding rate
$174.38 for 120 lb seeding rate
Avg: is $202.69

Note: The value of spelt ranged from $0.10 to $0.38 /lb ($4.00 to $15.20 /bu)

Field	Avg $ / bu	Yield	Value / acre
Field #1	$9.60	73.3	$703.68
Field #2	$9.60	78.1	$749.76
Field #3	$9.60	76.7	$736.32
		Avg Value / acre	**$729.92**
Straw	Bales /acre	price	Value / acre
Value of Straw	80	$5.00	$400.00
		Total value /acre	**$1,129.92**

Profit/Loss:

Gross Profit (average value between seeding rates plus straw):	$1,129.92
Production Cost (Average):	$202.69
Net Profit:	$927.23

Based on the information above it was Laine's Farms experience that the total cost per acre of spelt production for the purpose of using in livestock feed was on average $202.69/acre.

For comparison, it was Laine's Farms experience that the total cost per acre of WSG for the purpose of biofuel (pellet form) was a total of $421.56/acre.

Although there is a substantial difference in production cost per acre between the two, one must consider that spelt production appears to have a far better return on investment per acre for the following reasons. Specifically, spelt's harvest is immediate, as opposed to WSG where after planting, establishment can take 2 years or longer before a harvest can occur. Additionally, since spelt can also be harvested for straw AFTER it has been harvested for the gain, a secondary economic use and market is realized for the crop within the same harvest year, as opposed to WSG being typically harvested once a year (one cutting) with no other secondary economic use market from the same crop field.

Also note that drying and storage of spelt is also similar to wheat. However, unlike wheat, the tough hull remains on the spelt kernel through harvest, shipping, and storage.

It also must be clearly understood that the spelt grain end-use for this project was solely intended use in livestock feed which did not require de-hulling, unlike spelt used for human consumption (food-grade). However, the grain intended for livestock feed was ground or milled before use which is industry standard. Furthermore, food-grade spelt is typically grown on contract with a processing company, therefore having a contract in place before raising spelt for human consumption (food-grade) is highly recommended, and by industry standards, a necessity for a return on investment.

Figure 7: Spelt in Hull

Additionally, organic spelt may bring a higher return depending on the price premium, marketing cost, and yield. Additionally, transportation expenses to an out-of-state buyer, which are not included in any of estimates contained herein, could significantly decrease returns. Lastly, producers should be certain to also include the expense of marketing spelt, should they not have a contract buyer in place, do not have established clientele or are new to the market opportunities and trends.

III. C) Identification of spelt market options in NJ and evaluation of spelt yield based on specific seeding rates used to maximize habitat potential for grassland dependent birds.

Spelt has been grown in Europe for about 300 years and was introduced to the United States in the 1890s. In the early 1900's there was up to 500,000 acres grown in the USA. However, with the development of the combine, spelt, requiring an extra step to remove the hulls, was replaced by uncovered wheat in many areas by the 1920s.

In recent years, spelt has reemerged as a viable product and a major cash crop, especially for organic and artisanal small grain growers in the health food market, both in the USA and in Europe. It is reported to be much easier to digest than wheat and its nutrients are more "bioavailable," that is, more readily accessed during digestion. (Janzen)[14] The grain also dissolves easily in water and thus facilitates nutrient absorption. Spelt is also much

[14] http://www.agmrc.org/media/cms/SpeltStory_0E4AE35188557.pdf

lower in gluten and has very high water solubility then other grains, such as wheat. Therefore, some individuals with wheat intolerance and gluten intolerance can eat spelt products with no ill effects. However, differences do exist with seed varieties.

Most of the nation's spelt acreage is in Ohio which grows between 100,000 and 200,000 acres of spelt annually, about 10 times more than any other state. In nationwide spelt production Ohio is followed by Pennsylvania, Michigan, Indiana, Kansas, North Dakota, South Dakota, Nebraska, and Minnesota. Limited production of spelt is also occurring in Wisconsin, Iowa, Illinois, Indiana, Montana, Wyoming, and Texas. (Stallknecht, et al,)[15]

In NJ, information on spelt production is extremely limited because it is so new to the region. To the best of our knowledge, only two producers are actively growing spelt on a large scale basis in NJ, Jim Laine of Laine Farms (Hillsborough) and Greg Manners of Terraceland Farm (Ringos). Laine Farms has reached out to the spelt seed supplier French's Hybrids Inc. of Wakeman, Ohio and according to their records, the above information for NJ producers is correct.

The future for spelt production in the region is encouraging, since spelt's growth habits, soil and climate requirements are easily met throughout the State of NJ. Furthermore, as more producers become better educated on its production and market value, especially taking into account recent spelt consumer and production trends in other states, spelt is positioning itself to moving out of a niche market into a more of a mainstream commodity market.

Ground spelt is used primarily as an alternative feed grain to oats and barley. Its nutritional value is close to that of oats. The protein content of the Champ variety of spelt is about 11.7%, compared to 12% to 13% for oats. The spelt hull has nearly as much feeding value as the kernel. Spelt can also be used as a food grain after removal of the hulls[16]. American food manufacturers in this country have begun to use spelt to meet the nation's increasing demand for pasta and high fiber cereals. Spelt can also be used in flour and baked goods to replace soft red winter wheat. (E.S. Oplinger[1], E.A. Oelke[2], A.R. Kaminski[1], K.A. Kelling[1], J.D. Doll[1], B.R. Durgan[2], and R.T. Schuler[1])[17]

Data on spelt production in the USA, from the U.S. Department of Agriculture (USDA) Census on Agriculture, indicates farmers are growing both certified organic and conventional spelt. However, few specific statistics on spelt exist, in part because it is often categorized as a kind of 'wheat' or lumped into a category entitled "other grains." Also, fine-tuned data collection has not focused on spelt since the grain it still considered a niche market, especially as compared to wheat. For comparison, the US planted on average 55.04 million acres of wheat in between 2010 and 2013, or more than 275 times as much as spelt grown annually in the top spelt production state Ohio.[18]

A 2004 publication of the Washington State University Extension notes, perhaps not surprisingly, much about spelt supply and demand is not revealed in USDA data.

[15] Stallknecht, G.F., K.M. Gilbertson, and J.E. Ranney. 1996. Alternative wheat cereals as food grains: Einkorn, emmer, spelt, kamut, and triticale. p. 156-170. In: J. Janick (ed.), Progress in new crops. ASHS Press, Alexandria, VA.
[16] 2013 Alternative Field Crops Manual University of Wisconsin Cooperative Extension Service, the University of Minnesota Extension Service and the Center for Alternative Plant and Animal Products
[17] 1Departments of Agronomy, Soil Science and Agricultural Engineering, College of Agricultural and Life Sciences and Cooperative Extension Service, University of Wisconsin-Madison, WI 53706. 2 Department of Agronomy and Plant Genetics, University of Minnesota, St. Paul, MN 55108. May, 1990.
[18] http://www.ers.usda.gov/data-products/wheat-data.aspx

However, industry reports from numerous farmers, millers, consumers and market observers indicate spelt has become increasingly popular over the last 20 years, and a wide variety of products containing spelt—from snack foods like pretzels to pasta and bread—are now readily available in many grocery stores.[19], Today there is new interest in spelt among people who are looking for alternative foods, heirloom varieties, or certified organic grain products." (Cambell 1997)[20]

In general, the trend toward a wider variety of specialty grain products seems on the rise. Consumers have discovered the health benefits of ancient varieties (such as spelt) and the rising popularity of gluten-free products has increased usage of non-gluten containing specialty grains, such as spelt. (Thilmany 2009)[21]

Companies distributing spelt products nationally include Purity Foods, Berlin Natural Bakery, based in Berlin, Ohio, and Lentz Spelt Farms, based in Marlin, Washington. Other firms such as Nature's Path, Rudi's Organic Bakery, and Doctor Kracker sell spelt products labeling them as "alternative" or "heritage" grains. At the same time, new cooperatives and companies are also marketing locally-grown spelt around the country at artisanal bakeries and markets. Some US companies are even importing spelt from Canada and Europe at times, to meet US consumer demand and address consumer concern associated with purchasing and consuming other grains that are genetically modified organisms, (GMOs). (World Grain 2012)[22]

Although the human consumption market for spelt is growing, for the last 6 years Laine Farms has been growing spelt specifically for non-human consumption purposes (i.e. livestock feed). Higher animal feed prices and fluctuating weather patterns in recent years lead to Laine Farms to try spelt an alternative grain for its livestock feed mill operation. Spelt is has been widely used as feed for beef, dairy, hogs and horses because the hull has nearly as much value as the kernel. If thrashed severely, it is considered the value as barley. Spelt will usually average slightly higher in protein than oats, depending on variety. Spelt can be fed as whole grain by itself or in a complete ration, however animal owners should ALWAYS consult their feed nutritionist for a program that fits their operation. Laine Farms has had successes with spelt an alternative grain for older horses that need highly digestible fiber sources in their diet.

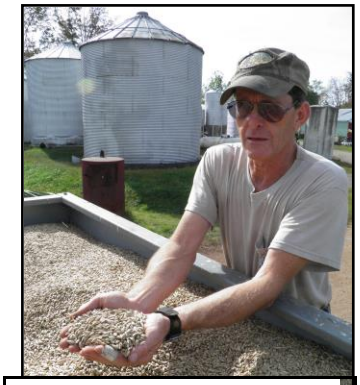


Figure 8: Jim Laine with Harvested Spelt Grain

According to a 2013 article by an industry trade magazine, Feed Management Systems, this exact scenario of farmers searching for economical viable alternative grains for livestock, including spelt is becoming more popular in light of difficult economic times.

Additionally, by not dehulling the seed (NOTE: dehulling is the greatest expense to the producer if production is for the human consumption market) the use of spelt and its by-products for livestock feed may hold the greatest promise for future use.

[19] http://cru.cahe.wsu.edu/CEPublications/eb1977/eb1977.pdf
[20] Campbell, K. G. 1997. Spelt: Agronomy, Genetics, and Breeding. Plant Breeding Reviews, Ed. J.Janick. Vol. 15, J. Wiley & Sons. P. 187–213.
[21] Thilmany 2009, http://baking-management.com/rd_applications/rise-whole-grains-0809/#ixzz2VqGzpU5f
[22] World Grain 2012 http://www.nxtbook.com/sosland/wg/2012_01_01/index.php?startid=48

In a 2004 report published by the Australian Department of Industry & Investment, "In animal feed the hull fiber of spelt is particularly beneficial for ruminants, such as cattle, as it increases the digestibility of the feed and reduces acidosis problems. Its low amylase and fibrous hull reduce the speed of sugar production, while high protein is attractive in relation to lower energy levels. Spelt could therefore also be considered as an additive in finishing-off feed rations. European and some North American farmers have traditionally used spelt as a feed-grain substitute for oats because cold, wet springs often hindered spring oat planting. The feed value of hulled spelt is similar to that of oats." [23]

For comparison, below is the nutritional analysis of Spelt and Oats as listed in the 2005 Feed Composition Tables in Beef Magazine developed by Dr. Rod Preston[24].

Feedstuff	DM	TDN	NEm	NEg	CP	ADF	NDF	eNDF	CA	P	K	CL	S	ZN
	%	%	Mcal/cwt	Mcal/cwt	%	%	%	%	%	%	%	%	%	ppm
Spelt	88	75	79	50	13	17	21	34	.04	.4	.4		.15	47
Oats	89	76	81	52	13	15	28	34	.05	.41	.5	.11	.2	40

1 Reported on a dry matter basis

Spelt is a tall plant and does not need as high a nitrogen level as wheat. So from an agriculture production standpoint incorporating spelt into one's rotation has benefits to the farming operations overall with improvement to soil and water quality because spelt typically uses less fertilizer (ex: Spelt requires about 25-50% less nitrogen than wheat[25]) and chemicals for weed control than conventional crops and it can be utilized as an alternative cover crop. Spelt grows successfully in poorer soils (poorly-drained, low-fertility) than wheat, including heavy clay, and can tolerate somewhat dryer conditions as well, including sandy soils[26], thus it is close to comparison to native grasses also being somewhat drought tolerant and typically requiring no irrigation. Based on this information alone, regarding soil and moisture requirements, spelt theoretically could be grown in every physiographic region of New Jersey.

Spelt is also very resistant to frosts and other extreme weather conditions and the grain's exceptionally thick husk protects it from pollutants and insects. As spelt is a pure, original grain and not biologically modified in any way, it is very resistant to the crop diseases that often plague modern crop varieties and grows quite successfully without the application of herbicides, pesticides, or fungicides.[27]

Spelt typically will mature slightly later than wheat. The heads will "cane" and turn downward when fully mature. Direct cut with a combine is most efficient. However, it can be windrowed and threshed, similar to winter wheat; however, the combine should be set at a slower cylinder speed. Spelt is very easy to harvest in a dry condition, as it will dry quickly after a rain. No known moisture charts are available for spelt and determining moisture is somewhat by the "seat of the pants". When harvesting, an effort what made to not thrash the kernels, but rather just break the head apart cleanly. Typically, a concave clearance will be the same as wheat but slightly slower cylinder/rotor speed. Chaffer and

[23] http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0003/380784/Organic-spelt-production.pdf
[24] http://beefmagazine.com/mag/beef_feed_composition_tables
[25] Ohio Agronomy Guide http://ohioline.osu.edu/b472/
[26] http://www.hort.purdue.edu/newcrop/afcm/spelt.html
[27] Ohio Agronomy Guide http://ohioline.osu.edu/b472

sieves will need a rather wide setting to accommodate the bulk but, reduce air output to a minimum level because it can be easy to blow spelt "right out the back."[28]

Once the grain is harvested, a producer should also consider bailing the straw as a second crop. Spelt straw is very absorbent as a bedding and bales of 100 bales (2 ton) per acre are common[29].

As indicated in Section 2 of this report, Laine Farms purposely varied seeding rates of spelt in an attempt to theoretically create habitat similar to a planted warm season grass field (i.e. typical warm season grass fields for wildlife are planted at a seeding rate of 6-8 lbs./acre, for biomass production the seeding rates are higher, 10-12 lbs./acre). By lowering seeding rates of the spelt it was thought that the field would inherently contain a greater number of bare patches of soil and also allow for more low herbaceous growth between the spelt. However, by lowering seeding rates from the recommended typical 120-lbs/acre, actual crop yield needed to be measured to see if a lower seeding rates still made spelt an economically feasible crop while providing suitable habitat. The following is the results of the harvests over the 3 years of the study:

III.C.1) 2014 Yield

(NOTE: All spelt fields were rotated around the study site during the length of the study. -below are the soil types in which the spelt fields were planted over the course of the study.)

Project Site Soil Types of Spelt Fields

Soil Type*	Soil Description	Drainage
BucC2	Bucks silt loam, 6 to 12 percent slopes, eroded	Well-drained
BucB	Bucks silt loam, 2 to 6 percent slopes	Well-drained
PeoC2	Penn channery silt loam, 6 to 12 percent slopes, eroded	Well-drained
PeoB	Penn channery silt loam, 2 to 6 percent slopes	Well-drained

* https://websoilsurvey.nrcs.usda.gov/app/

According to Section 600 Table B –Standard Weight Per Bushel for agricultural Commodities (found in the Administrative Code Title 8: Chapter 1, subchapter p: Part 600, Section 600 – the standard weight per bushel of Spelt is 40 pounds per bushel.

Data collected from the 2014 spelt harvest, revealed the following:
Field #1 produced 59.29 bu/acre
Field #2 produced 63.48 bu/acre
Field #3 produced 71.73 bu/acre

Although it appears that lowering the seeding rate did not produce yields below the 40 lb/ac standard, this above standard yield for all fields may be influenced by weather conditions experienced during the 2014 growing season and/or location of each field on the landscape.

[28] http://www.frenchshybrids.com/index.php/spelt-usage
[29] http://www.frenchshybrids.com/index.php/raising-spelt

III.C.2) 2015 Yield

2015 was a difficult year for growing winter grains in our area. Both yields of barley and spelt in the region were down with some fields not harvested. The spelt crop was planted after harvesting soybeans which was delayed because of poor harvesting conditions.

Due to this, the spelt was planted late and didn't get a good start going into the early winter of 2015. The drought conditions of May 2015 further stunted the crop and at harvest the crop was half as tall as normal. The combined adverse weather conditions from the fall of 2014 through spring of 2015 resulted in significantly reduced yields and Field #2 not being harvested.

Data collected from the 2015 spelt harvest, revealed the following:

Field # 1 produced 23.6 bu/acre
Field # 2 Not harvested due to crop failure
Field #3 produced of 26 bu/acre

Field #1 was seeded at 80 lbs. / acre and Field #3 was seeded at 120 lbs. / acre. Field #3 had only a ~10% yield increase over Field #1 despite being seeded at a 50% higher rate. Again, this outcome is most likely influenced by weather.

III.C.3) 2016 Yield

Data collected from the 2016 spelt harvest, revealed the following:
Field #1 produced 73.3 bu/acre
Field #2 produced 78.1 bu/acre
Field #3 produced 76.7 bu/acre

Despite altering the recommended seeding rate, all fields yields once again (2 out of 3 years of the study), were above the average wheat yield for NJ. In fact, Field #3 seeded at 80/ lb/ac recorded the second highest yield of the three project fields.

It appears that lowering the seeding rate did not adversely affect the yields. All the fields had the same fertilizer rate applied. However, the fields with the higher seeding rate may benefit from an increaser fertilizer rate. This above standard yield for all fields again may be may be influenced by weather conditions experienced during the 2016 growing season and/or location of each field on the landscape. However, it should be noted that although limited by the short length of the study, results do indicate that spelt can be successfully grown in New Jersey. Additionally, dependent upon weather and site conditions (as with any crop) spelt's potential for above typical wheat yields is possible in New Jersey[30].

It should be noted that all three field treatments (2013-2015) were within the typical yield range of wheat grown in NJ[31].

[30] Typical average wheats for NJ is 52 +/- bu/acre
[31] All Wheat area planted and harvested, Yield and Production 2013-2015. Crop Production Summary, USDA, NASS

III.D) Grassland Bird Presence/Abundance Surveys Associated with Spelt Fields

From a wildlife conservation perspective, the grant targeted the spelt fields as serving a dual use to provide both a potentially sustainable alternative agricultural crop as well as critical grassland habitat for grassland dependent bird species. In an effort to assess habitat potential of the spelt fields NJAS conducted bird surveys.

Please note that all results to date are preliminary. Due to the short length of the grant period and weather variables (2015 experienced some crop failure due to excessive drought conditions), survey results have not been implemented long enough to conduct solid statistical analysis as related to crop management techniques for habitat. However, the research work conducted during the grant period does provide the preliminary base-line information to consider further research into spelt as a potential surrogate for vegetation conducive to grassland birds on production land and/or land being converted from grasses/hay in favor of a commodity crop.

III.D.1) Data Collection Methods

D.1.a) Surveyor Training

NJ Audubon Research Department staff who are trained in survey methodology and bird identification required to conduct counts for in target grassland species[32] including, but not limited to: Grasshopper and Savannah Sparrows, Bobolink, Eastern Meadowlark, Horned Lark, Northern Harrier and American Kestrel, were utilized to collect the bird survey data. The above referenced grassland bird species can be easily heard or seen and are sufficiently distinct from each other that trained individuals can effectively count them.

NJA research staff are trained in visual and auditory identification of target species, data collection and recording, species observation mapping, distance sampling, and web-based data entry. Research staff were supplied with the necessary materials to complete the surveys, including maps of all survey points, aerial photographs of each survey point, detailed protocol, data sheets, bird song CDs, target species identification information.

D.1.b) Survey Design and Protocol

Four surveys were conducted during the breeding season (between May 15 and July 15) to identify grassland and scrub/shrub species using the spelt fields and control areas. The location of spelt plantings, and therefore survey locations, varied across the two years of the study.

In 2014, these surveys were conducted on: May 23th, June 11th, June 25th, and July 11. In 2015, surveys were conducted on: May 20/21st, June 11th, July 1/2nd, and July 14th. In 2016, they were conducted on: May 27th, June 10th, June 29th, and July 13th.

[32] Target Grassland Species for the purposes of this grant are defined as any bird species that utilizes grasslands for breeding and foraging and appears on the list of endangered and threatened wildlife species for the state of New Jersey http://www.nj.gov/dep/fgw/tandespp.htm. Target Grassland Species also include bird species that appear on the list of State Species of Special Concern for the State of New Jersey http://www.nj.gov/dep/fgw/ensp/pdf/spclspp.pdf.

Surveys were conducted using a modification of the statewide NJ Audubon Citizen Science Grassland Bird Survey protocol. In addition, NJA incorporated methodologies for estimating detection probabilities, including distance sampling (Buckland et al. 2001[33], Diefenbach et al. 2005[34]), removal methods (Farnsworth et al 2002[35]), and methods that combine these approaches (Farnsworth 2005 [36]). Specifically, NJA incorporated a distance measure in our survey design that requires the observers to record the location of detected target species at three distances (<25m, 25-100m, and >100m) from the survey point. NJAS split the 10-minute point count period into two time intervals, 5 minutes and 5 minutes, to allow for removal analysis. Furthermore, NJA documented whether each bird recorded was heard, seen or both.

Surveys were not conducted during rain or periods of high winds (greater than 12mph {Beaufort[37] 3}). Surveys took place from one half hour before to four hours after sunrise (approximately between 5:30 AM and 9:30 AM).

[33] Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers, and L. Thomas. 2001. Introduction to distance sampling. Oxford: Oxford University Press.

[34] Diefenbach, D. R., D. W. Brauning, and J. A. Mattice. 2003. Variability in grassland bird counts related to observer differences and species detection rates. Auk 120:1168-1179.

[35] Farnsworth, G. L., K. H. Pollock, J. D. Nichols, T. R. Simons, J. E. Hines, and J. R. Sauer. 2002 . A removal model for estimating detection probabilities from point-count surveys. Auk 119: 414-425.

[36] Farnsworth, G. L., Nichols, J. D., Sauer, J. R., Fancy, S. G., Pollock, K. H., Shriner, S. A., and T. R. Simons. 2005. Statistical Approaches to the Analysis of Point Count Data: A Little Extra Information Can Go a Long Way. USDA Forest Service Gen. Tech. Rep. PSW-GTR-191: 736-743.

[37] Beaufort Wind Scale: One of the first scales to estimate wind speeds and the effects was created by Britain's Admiral Sir Francis Beaufort (1774-1857). The scale starts with 0 and goes to a force of 12. The Beaufort scale is still used today to estimate wind strengths. http://www.spc.noaa.gov/faq/tornado/beaufort.html

III.D.2) Results - Grassland Bird Data

Table 1. Target grassland bird and scrub/shrub species observed on point count surveys at experimental spelt fields and control points, 2014.

	Spelt_01	Spelt_02	Spelt_03	Spelt Control_01	Grassland Control_02	Grassland Control_03	Grassland Control_04
Target Grassland Species							
American Kestrel						x	
Bobolink					x	x	x
Eastern Meadowlark						x	x
Grasshopper Sparrow	x	x	x		x		x
Horned Lark							
Northern Bobwhite							
Northern Harrier							
Savannah Sparrow					x		
Upland Sandpiper							
Vesper Sparrow							
Scrub/Shrub Species							
Black-billed Cuckoo							
Blue Grosbeak							
Blue-winged Warbler						x	x
Brown Thrasher					x		
Chestnut-sided Warbler							
Eastern Bluebird							x
Eastern Towhee			x	x			x
Field Sparrow	x	x	x	x	x	x	x
Golden-winged Warbler							
Indigo Bunting	x	x	x	x	x	x	x
Prairie Warbler							
Red-winged Blackbird	x	x	x		x	x	x
White-eyed Vireo							
Yellow-billed Cuckoo							
Yellow-breasted Chat							

Table 2. Target grassland bird and scrub/shrub species observed on point count surveys at experimental spelt fields and control points, 2015.

	Spelt_04	Spelt_05	Spelt_06	Spelt Control_02	Spelt Control_03	Grassland Control_03	Grassland Control_04
Target Grassland Species							
American Kestrel			x				
Bobolink					x	x	x
Eastern Meadowlark					x	x	
Grasshopper Sparrow					x		x
Horned Lark							
Northern Bobwhite							
Northern Harrier							
Savannah Sparrow							
Upland Sandpiper							
Vesper Sparrow							
Scrub/Shrub Species							
Black-billed Cuckoo							
Blue Grosbeak					x		
Blue-winged Warbler							
Brown Thrasher							
Chestnut-sided Warbler							
Eastern Bluebird		x					
Eastern Towhee			x	x		x	x
Field Sparrow		x	x	x	x	x	x
Golden-winged Warbler							
Indigo Bunting	x	x	x	x	x	x	x
Prairie Warbler							
Red-winged Blackbird	x	x	x	x	x	x	x
White-eyed Vireo							
Yellow-billed Cuckoo							
Yellow-breasted Chat							

Table 3. Target grassland bird and scrub/shrub species observed on point count surveys at experimental spelt fields and control points, 2016.

	Spelt_07	Spelt_08	Spelt_09	Spelt Control_04	Grassland Control_03
Target Grassland Species					
American Kestrel		x*			
Bobolink				x	x
Eastern Meadowlark				x*	
Grasshopper Sparrow			x	x	
Horned Lark					
Northern Bobwhite					
Northern Harrier					
Savannah Sparrow				x	
Upland Sandpiper					
Vesper Sparrow					
Scrub/Shrub Species					
Black-billed Cuckoo					
Blue Grosbeak				x	x
Blue-winged Warbler		x			
Brown Thrasher					x*
Chestnut-sided Warbler					
Eastern Bluebird			x		
Eastern Towhee	x		x		
Field Sparrow	x	x	x	x	x
Golden-winged Warbler					
Indigo Bunting	x	x	x	x	x
Prairie Warbler			x		
Red-winged Blackbird	x	x	x	x	x
White-eyed Vireo					
Yellow-billed Cuckoo					
Yellow-breasted Chat					

*Observed outside of survey period

Figure 1. Location of bird survey points within experimental spelt fields and control sites, 2014.

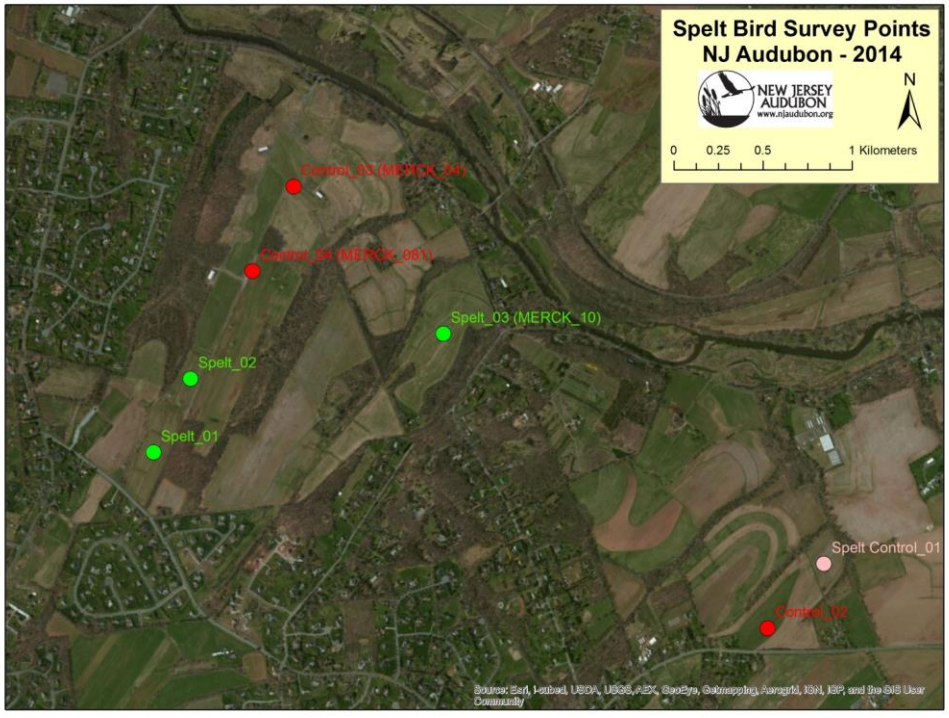


Figure 2. Location of bird survey points within experimental spelt fields and control sites, 2015. Points surveyed in 2014, but not 2015, are shown in gray.

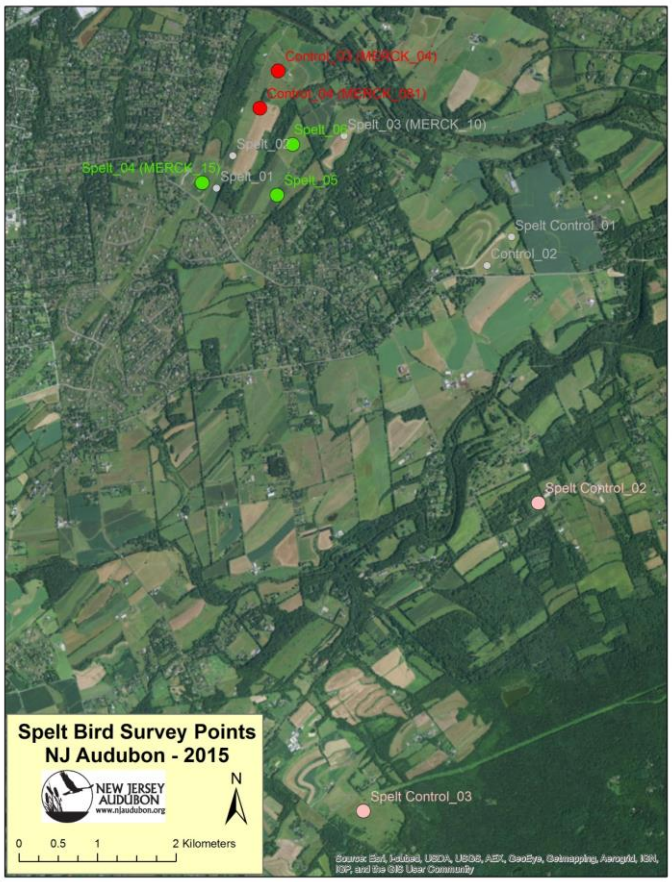
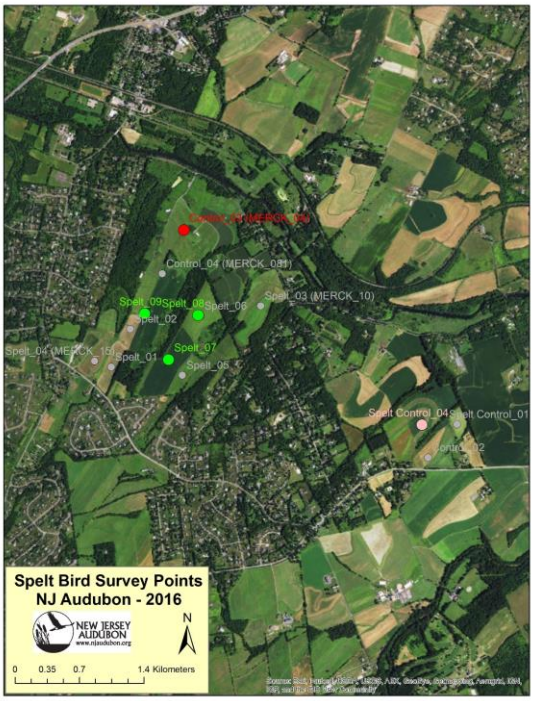


Figure 3. Location of bird survey points within experimental spelt fields and control sites, 2016. Points surveyed in 2015 and 2016, but not 2016, are shown in gray.



IV.A) Project Promotion, Training, Outreach

As part of the grant, information to promote and educate the public, as well as technical staff, on the progress of the spelt project was to be disseminated as information became readily available. Since the project was highly susceptible to varying weather conditions from year to year that impacts the growth of the crop (and thus can influence both bird use and crop yield), project information was limited to only very general information on the project overall. This was done in an effort to not prematurely present results that could be misinterpreted by the public and/or utilized in a way that could be misleading or biased.

With that in mind, the following is a list of promotional, educational articles and/or meetings that were completed by the Laine Farms in conjunction with NJA for the project.

- 10/10/2013 – NJA Conservation Blog Post: *Laine Farms and NJ Audubon Awarded USDA Conservation Innovation Grant* (2,125 views) http://www.njaudubon.org/SectionConservation/StewardshipProgam/StewardshipBlog/tabid/2006/entryid/202/Laine-Farms-and-New-Jersey-Audubon-awarded-USDA-Conservation-Innovation-Grant.aspx

- Spring-Summer 2014 – New Jersey Audubon Magazine: Page 5: *USDA Conservation Innovation Grant Awarded: Spelt* (Magazine readership 22,000,[38])

- May/June 2015 - Bird Watchers Digest, Vol 37 No.5 Page 15, Baicich, P., *Spelt Right*, (Magazine Impressions over 1 million[39])

- 6/12/15 – In Field Workshop/Town-Hall Meeting @ Spelt Project Fields for Firman E. Bear Chapter of the Soil and Water Conservation Society (Jim Laine & John Parke presenters): 16 attendees – representatives in attendance were from, NRCS, NJA, Rutgers, The State University, Rutgers - NJ Agricultural Experiment Station, Princeton-Hydro, Various NJ County Soil Conservation Districts.

- 6/17/15 – In Field Presentation @ Spelt Project Fields for NJ USDA-NRCS State Technical Committee Meeting (Jim Liane & John Parke presenters): 34 attendees – representatives in attendance were from: NRCS, NRCS Earth Team, Duke Farms, NJCF, NJDFW, Growmark FS, National Wild Turkey Federation, USFWS, NJDEP/DWQ, SADC, NJRC&D, NJWSA, NJFB, PPA, NJDEP/DWQ/BPR, NJA and associated producers.

Please note NJA did reach out to NJ Farmer, Feed Management Systems, as well as The Star Ledger, Daily Record and the NJ Agricultural Leadership and Development Program (NJALDP) in an effort to promote the project, however these entities did not respond to our solicitations.

[38] From personal conversation with NJ Audubon magazine Editor and Layout Designer, Rick Radius and Joan Snider -1/26/14

[39] http://www.birdwatchersdigest.com/bwdsite/about/advertising/advertising-welcome.php

Figure 9: Jim Laine gives Presentation at Spelt Fields (6/12/15 on left) & (6/17/15 on right)

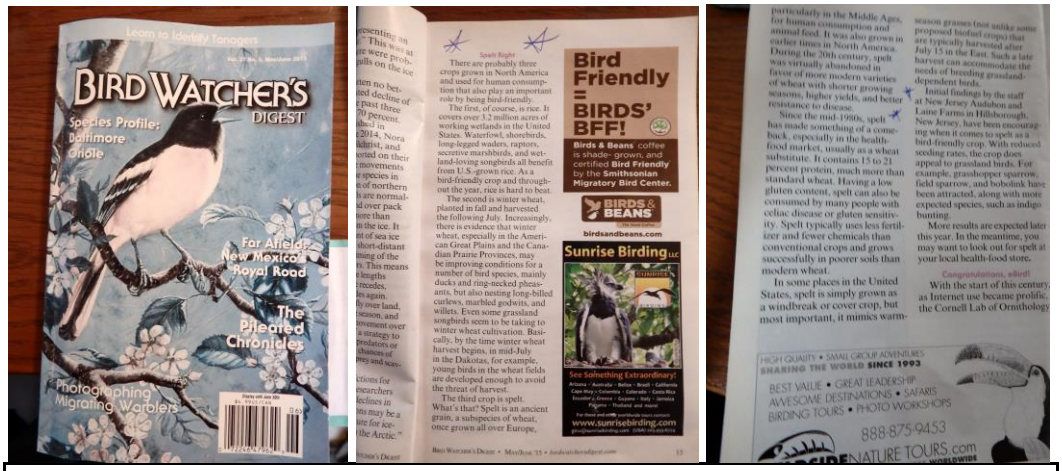


Figure 10: Bird Watchers Digest Spelt Article 2015

V) Discussion

A.) Project Transferability

The project itself is easily transferable to other producers in NJ, as well as, producers in other states. This is particularly apparent when you realize that all planting, spraying, and harvesting of spelt can be done with conventional farm equipment and existing markets for the product are either available now or on the rise.

However, as easily transferable it is in concept and equipment to plant, establish and harvest spelt, where the placement of the field on the landscape adjacent to other crops or forested areas should be considered if the objective is to attract grassland dependent bird species.

B.) Project Expectations (Met / Not Met)

Overall, the expectations of spelt as a potential surrogate for WSG for habitat use by grassland dependent birds was met. However, the placement of the spelt fields rather than adjusting seeding rates, appear to be the driving factor on bird use of the spelt fields.

Additionally, production cost/income of spelt when compared to the production cost/income of warm season grass was found to be a much better option for a producer as

far as diversifying their crops, because of spelt's use in the current consumer market. Spelt has a current market established as both an animal feed and grain for human consumption. Additionally, unlike WSG; spelt can be planted with conventional farm equipment so costs pertaining to obtaining specialized planting or harvesting equipment and the maintenance of that equipment are not applicable. Furthermore, unlike WSG crops planted under current USDA programs, entire fields of spelt can be harvested while still leaving enough structure on the fields for winter bird cover. Also unlike WSG, spelt does not have to wait years for establishment in order to be harvested, thus making it a more of an economic attractant to producers considering diversifying crops in both the short and long term.

Given the limited timeframe (3 years) of the grant period one must consider that all data collection for this project should be considered "preliminary" at best. In order to make definitive statements regarding bird usage of the spelt fields, as well as, comprehensive analysis of costs/income for production/income on the crops mentioned in this study, long term studies are more appropriate. This is due to a significant number of variables that can affect the study each year, including but not limited to, fluctuating energy and crop production costs (global market), fluctuating supply and demand (consumer markets), fluctuating weather and vegetation patterns effects on breeding birds and crop production.

With this information in mind, Laine Farms and NJA have not prepared a fact sheet for the use of spelt as a surrogate for WSG as suitable breeding habitat for grassland dependent birds. We instead recommend that additional research is needed (i.e. long term studies) of spelt used in this capacity in order to gain addition information to support the preliminary findings as outline herein.