

Commercial Application of Switchgrass as Renewable Alternative Bedding for Broilers in a Single-Cycle Production System

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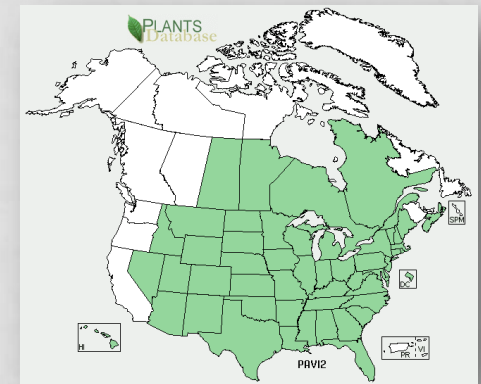
THE PROBLEM:

- Increase in diversion of wood shavings
- Variability and uncertainty in shavings market
- Availability of renewable, alternative bedding products



INTRODUCTION TO SWITCHGRASS

- 20 years continuous production (Wurzbacher, 2014)
- Produce biomass
 - 8.97-13.45 Mg/ha (Wurzbacher, 2014)
- Can be grown on marginal land (Hall, 2008)
 - Poor drainage
 - Poor fertility
- Native species
- Dries down in field (<20% moisture) (NRCS, 2011)



HISTORICAL PERFORMANCE OF SWITCHGRASS AS POULTRY BEDDING

- **Mississippi State** (Davis et al., 2010)
 - Replicate pen trial
 - Live performance and carcass wt not affected
 - Foot pad dermatitis lower for birds on switchgrass
- **University of Delaware** (Brown and Thomas, 2012)
 - 2 commercial scale switchgrass studies
 - Smaller particles prevent caking
 - 25 mm
- **Mississippi State & Auburn** (Davis et al., 2015)
 - Switchgrass performed equally to pine shavings in pen trial
 - No difference in performance over 3 flocks
 - Exception: 42 d FCR (Pine shavings > switchgrass)
 - Ammonia flux not different

PENN STATE SWITCH WORK

- Particle classification strongly influences potential litter performance
 - Switchgrass of 3 particle sizes vs softwood shavings (Barkley et. al., 2017)
 - Small switchgrass particles (5.3mm) perform similarly to softwood shavings
 - Longer switchgrass treatments (31.4 mm and 62.8mm) performed similarly to each other
 - Bird performance not impacted
 - Day 56 BW: Softwood shavings and 5.3 mm switch best
 - Footpad and breast feather cleanliness scores not different among treatments

HYPOTHESIS

Switchgrass with a larger particle size will not impact bird performance and welfare when compared to a smaller particle size, though it may impact litter performance

EXPERIMENTAL DESIGN

- Two barns- Cooperator's farm
 - Replicate cells bedded to 8.3 cm
- White organic broilers (Ross x Ross)
- December 2016-January 2017
 - 7 weeks
- SAS 9.4- One-way ANOVA - Blocked by house - ($P \leq 0.05$)

S2 Cell 1	S2 Cell 3	S2 Cell 5	House 9 (non-trial region)
S1 Cell 2	S1 Cell 4	S1 Cell 6	

Front

Rear

MATERIALS AND METHODS

BEDDING ANALYSIS

- 3 samples of each bedding type before bird placement
 - Percent moisture
 - pH
 - Particle distribution
 - Density
 - Water holding capacity : evaporative loss (Spiehs et al., 2013)
 - Nutrient profile
 - Total N, Ammonium N, Organic N, P_2O_5 , K_2O , Carbon
 - Energy density



MATERIALS AND METHODS

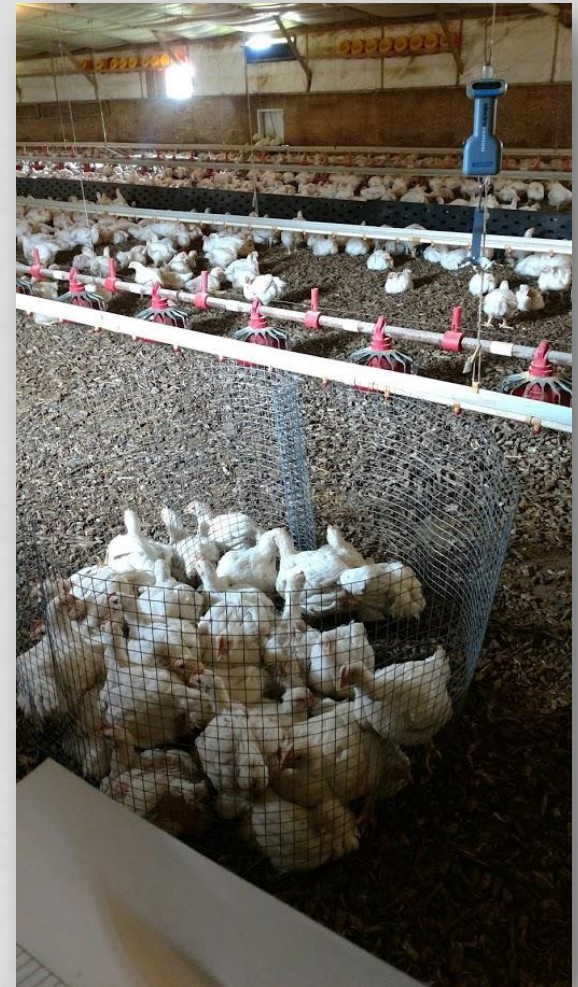
LITTER ANALYSIS

- Parameters evaluated at days 12, 35, and 45
 - Litter sampled from each cell for pH and moisture
 - Litter score (0-3)
 - Litter surface temperature
 - Ambient ammonia
- Nutrient analyses and energy density – day 46
 - Total N, Ammonium N, Organic N, P₂O₅, K₂O
- Ammonia flux – day 46 (Burley, 2009)
 - Dynamic flux chamber and INNOVA

MATERIALS AND METHODS

BIRD PERFORMANCE

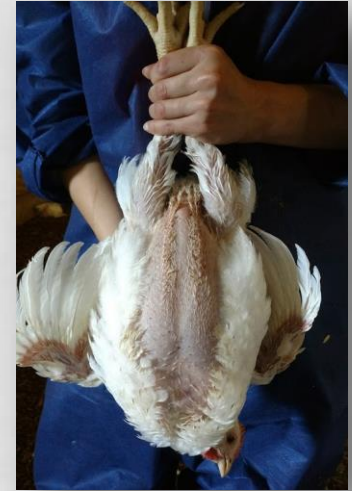
- Bodyweight – days 12, 35, 45
 - 25 birds evaluated per cell
- Mortality – days 1-9



MATERIALS AND METHODS

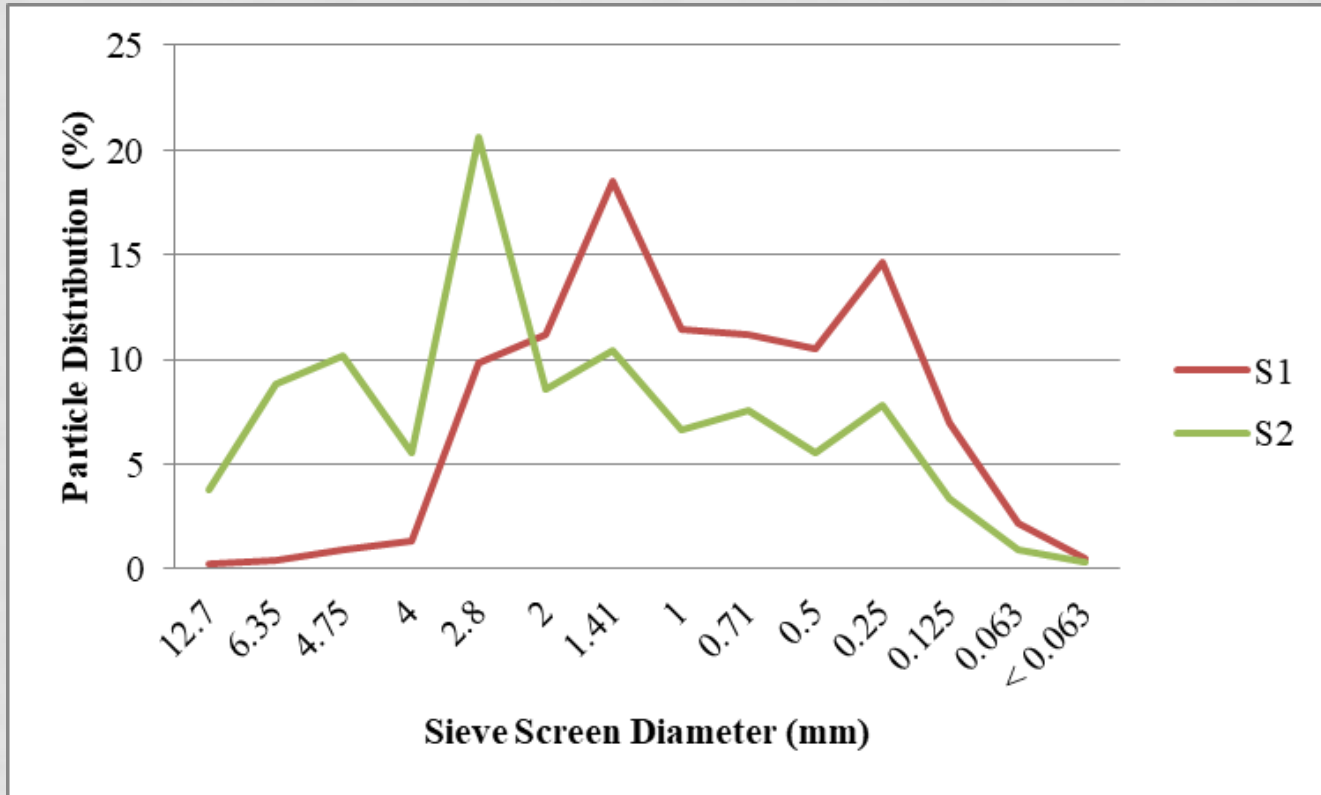
BIRD WELFARE

- Days 12, 35, 45
 - 25 birds evaluated per cell
 - Breast cleanliness scores: (0-2)
 - Amount of adhering debris to breast feathers
 - Footpad scores: (0-2)
 - 2 feet evaluated separately



Procedures adapted from the 5step™ Animal Welfare Rating Standards for Chickens Raised for Meat. Issued October 1, 2012 v2.0 ©2012 Global Animal Partnership

SWITCHGRASS PROCESSED VIA TUB GRINDER

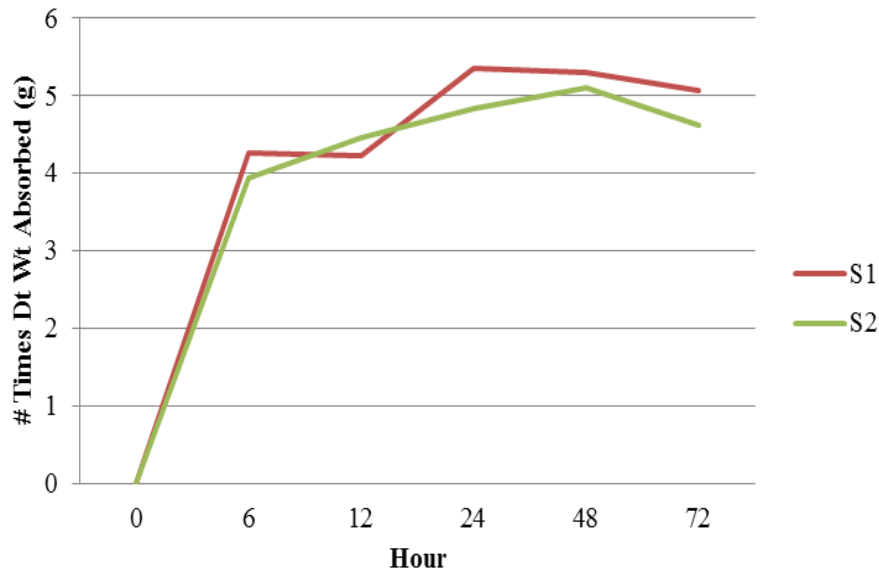


Down Screen diameter	Up Screen Diameter	Treatment
1.27cm	2.54cm	S1
2.54cm	5.08cm	S2

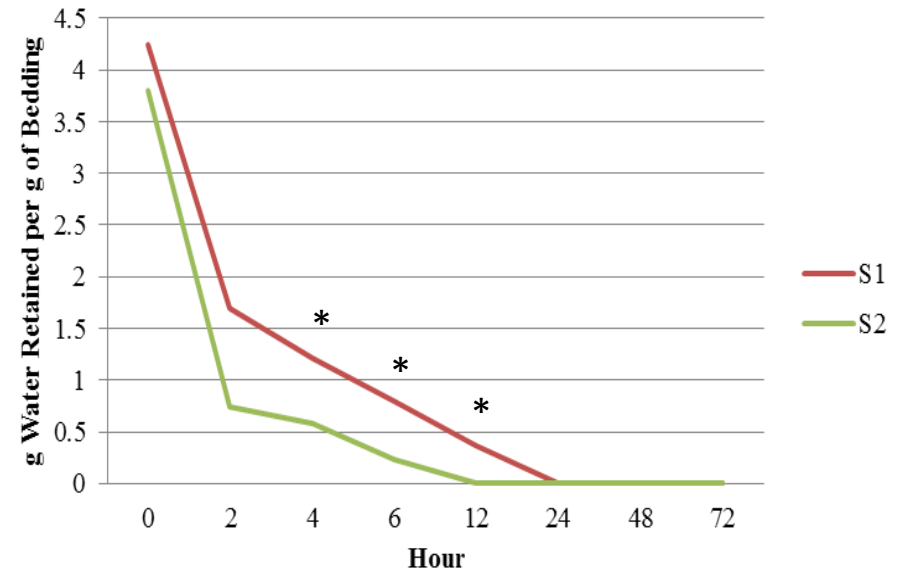


BEDDING PROPERTIES

Moisture Holding Capacity



Evaporative Loss



Treatment	(n)	Density	(n)	Moisture	pH
S1	3	0.1039 ^a	6	11.09	7.79
S2	3	0.0728 ^b	6	11.18	8.03
P-Value	---	<0.0001	---	0.8268	0.0997

LITTER PARAMETERS

- Litter temperature, pH, ambient ammonia, and flux not different by treatment
 - Did differ by house
 - Temperature ($^{\circ}\text{C}$) higher in house 9 on day 35 (27.77 vs 24.52)
 - Ambient ammonia (ppm) higher for house 9 on day 35 (64.89 vs 49.64)



Litter Moisture

<u>Treatment</u>	<u>(n)</u>	<u>Day 12</u>	<u>Day 35</u>	<u>Day 45</u>
S1	6	16.66	32.88	30.55
S2	6	17.23	33.60	33.30
P-Value	---	0.5674	0.7230	0.2981

Breast Cleanliness Scores (0-2)

<u>Treatment</u>	<u>(n)</u>	<u>Day 12</u>	<u>Day 35</u>	<u>Day 45</u>
S1	6	0.26	0.80	1.47
S2	6	0.24	0.69	1.20
P-Value	---	0.2522	0.3893	0.1446

Litter Scores (0-3)

<u>Treatment</u>	<u>(n)</u>	<u>Day 12</u>	<u>Day 35</u>	<u>Day 45</u>
S1	6	0.67 ^b	2.38 ^b	2.75 ^b
S2	6	1.33 ^a	2.79 ^a	2.96 ^a
P-Value	---	0.0017	0.0035	0.0203

Footpad Scores (0-2)

<u>Treatment</u>	<u>(n)</u>	<u>Day 12</u>	<u>Day 35</u>	<u>Day 45</u>
S1	6	0.09	0.48 ^b	1.22 ^b
S2	6	0.17	1.16 ^a	1.64 ^a
P-Value	---	0.3425	0.0013	0.0087

BIRD PERFORMANCE

- Mortality 1 – 9 days not affected overall
 - Day 1 – S2 > S1

Average Bird Bodyweight				
<u>Treatment</u>	<u>(n)</u>	<u>Day 12</u>	<u>Day 35</u>	<u>Day 45</u>
S1	6	0.25 ^b	1.71	2.42
S2	6	0.26 ^a	1.68	2.35
P-Value	---	0.0056	0.3265	0.1232

LITTER NUTRIENT AND ENERGY ANALYSES

Treatment	Moisture (%)	Total N (g/kg)	NH ₄ (g/kg)	P ₂ O ₅ (g/kg)	K ₂ O (g/kg)	Carbon (g/kg)	C:N	GJ/kg
S1	36.21	20.99	4.81	14.40	12.91 ^b	273.67 ^a	13.23 ^a	20.05
S2	39.35	22.77	5.43	16.73	16.52 ^a	247.20 ^b	10.91 ^b	18.08
P-value	0.1713	0.0734	0.2378	0.0888	0.0155	0.0149	0.0257	0.0786

n = 6

2.55-2.87 kg of single cycle switchgrass litter to 8.3cm = energy in 1 L propane
(21.3-24 lbs of litter to 1 gallon propane)

SUMMARY AND CONCLUSIONS

- Litter scores strongly affected by treatment
 - Footpad scores
- Litter moisture not affected by treatment
 - Breast cleanliness scores
- Bird performance was not affected by treatment
- Carbon in spent litter was highest for S1 (higher density bedding)

WHERE TO GO FROM HERE?

- Determine equipment to consistently processes switchgrass to particle specifications
 - Catalogue of particle size distributions from varying equipment types
- Conduct trial again in summer months
 - Is this product better for summer production



THANK YOU!

- NE-SARE
 - Graduate student grant
- Ernst Biomass
- Cooperating grower





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QUESTIONS?



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