Vegetative Buffers: From Biomass to Bedding

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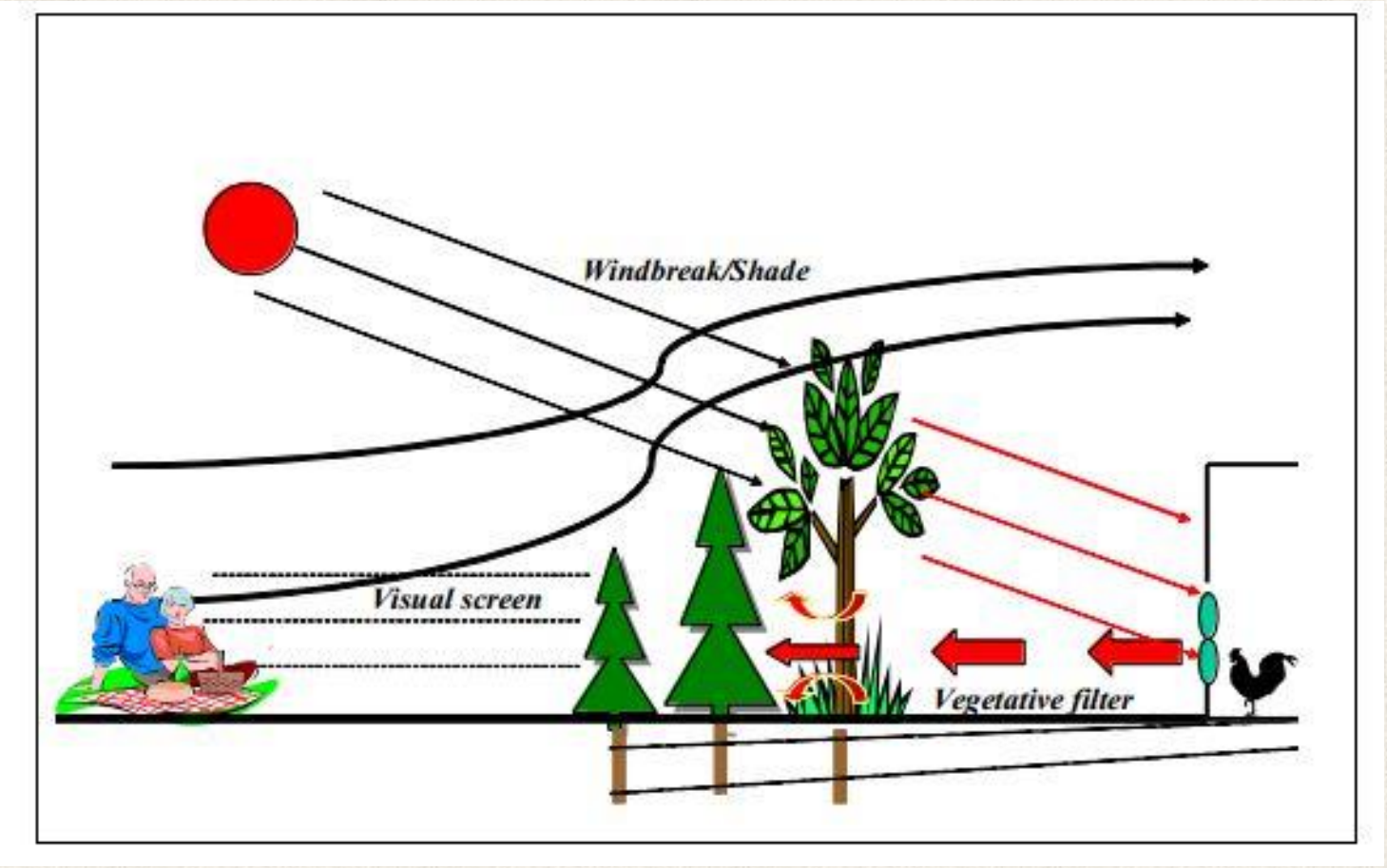
WHY USE BIOMASS AS BEDDING?

- Increase in wood shaving price
- Decrease in wood shaving availability
- Other studies note it is a good bedding
- Renewable resource
- Can grow on farm or purchase locally
  - Environmentally friendly

PLANTING OPTIONS

Vegetative buffer



PREFERRED BEDDING CHARACTERISTICS

- Wick moisture away from birds and readily release it
  - Maintain a low moisture over grow-out
- Maintain a low pH (innate)
- Suppresses ammonia volatilization
- Minimal cake
- Does not carry disease
- No effect on bird performance
- Keeps footpads clean and undamaged
- Keeps feathers clean

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

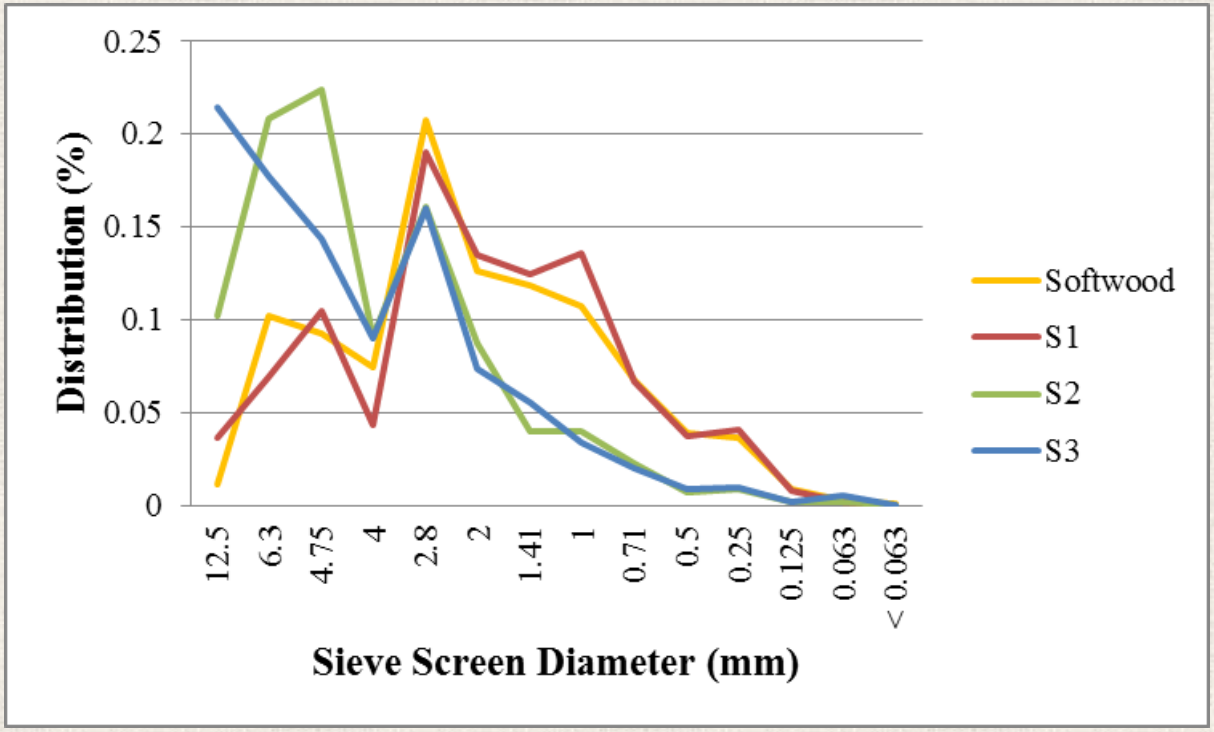
PENN STATE SWITCH WORK

- Particle classification strongly influences potential litter performance
  - Switchgrass of 3 particle sizes vs softwood shavings (Barkley et. al., 2017)
    - Small switchgrass particles (5.3 mm) perform similarly to softwood shavings
    - Longer switchgrass treatments (31.4 mm and 62.8 mm) 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

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

SWITCHGRASS PROCESSING VIA JD 6750 FIELD HARVESTER

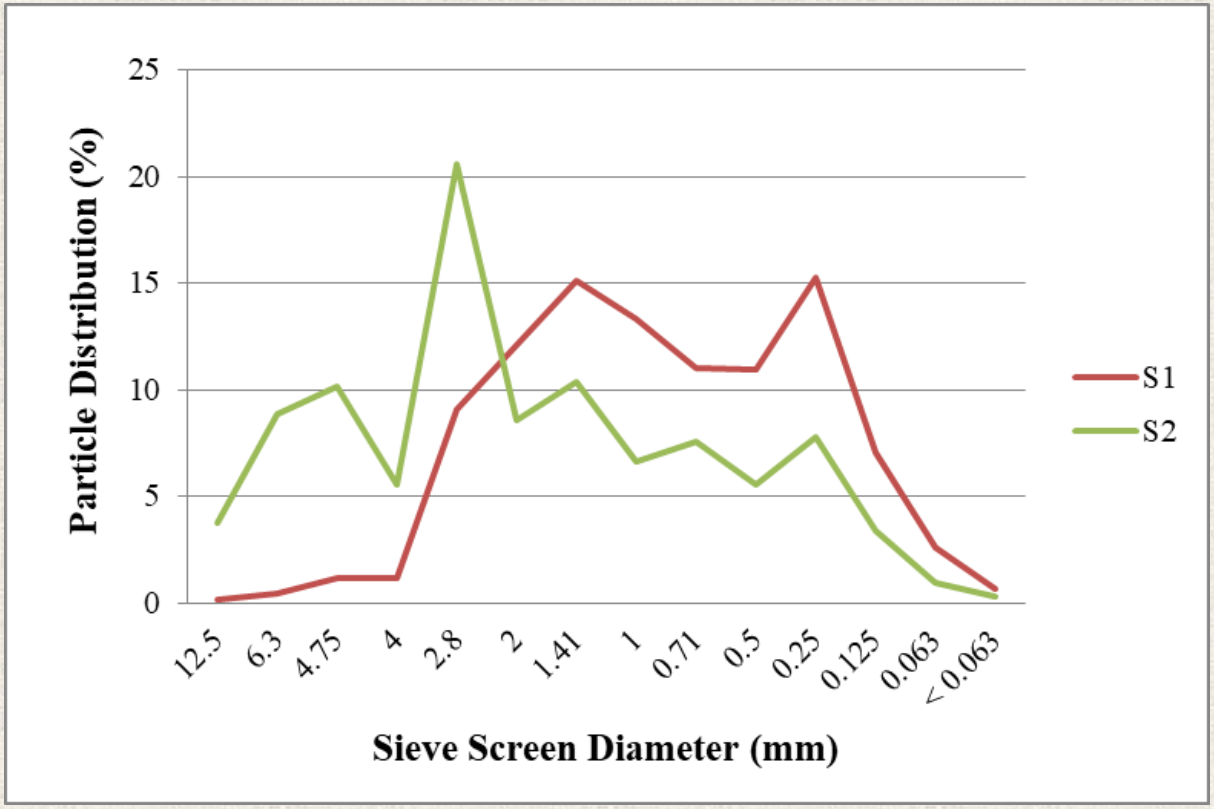
SWITCHGRASS PARTICLE SIZE DISTRIBUTION



# Knives	Transmission Speed	Avg. Particle Size	Treatment Assignment
48	1	0.53cm	S1
24	4	3.15cm	S2
12	4	6.27cm	S3

SWITCHGRASS PROCESSING VIA TUB GRINDER

SWITCHGRASS PROCESSED VIA TUB GRINDER



Down Screen diameter	Up Screen Diameter	Treatment
1.27 cm (1/2”)	2.54 cm (1”)	S1
2.54 cm (1”)	5.08 cm (2”)	S2

EXPERIMENTAL DESIGN

- Cooperator's farm
- Two barns
  - Replicate pens
- White broilers (Ross x Ross)
  - 7 weeks
  - Organic density
- December 2016-January 2017

Front

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

Rear

MATERIALS & METHODS: BEDDING

- Moisture
- pH
- Particle Size Distribution
- Moisture Holding Capacity
- Evaporative Loss
- Density
- Nutrient Analyses
- Energy Density

MATERIALS & METHODS: LITTER

- Litter Scores (0-3)
- Litter Temperature
- Ambient Ammonia
- Ammonia Flux
- Litter Sampling
  - % Moisture
  - pH
- Nutrient Analyses
- Energy Density

Drager pull tubes

INNOVA acoustic field gas monitor and dynamic flux chamber

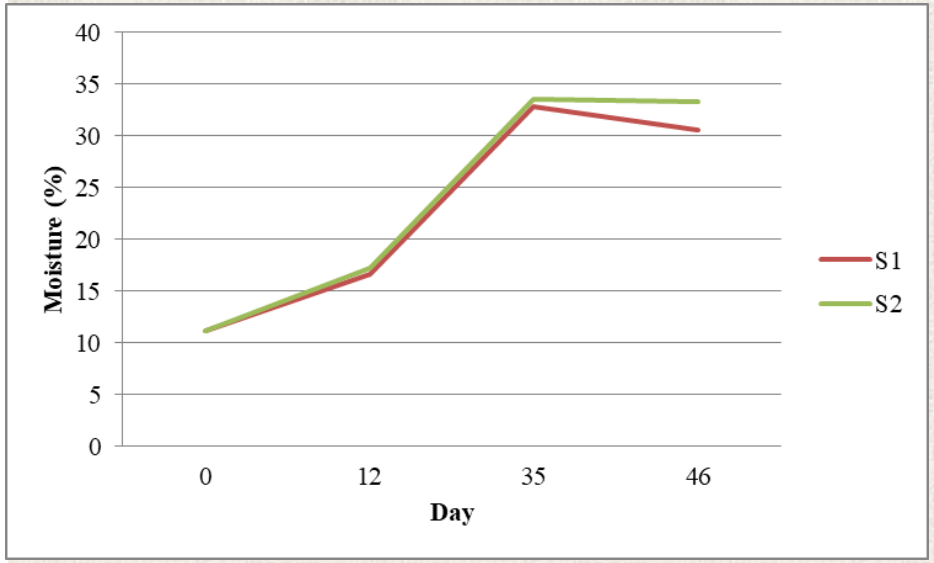
MATERIALS & METHODS: BIRDS

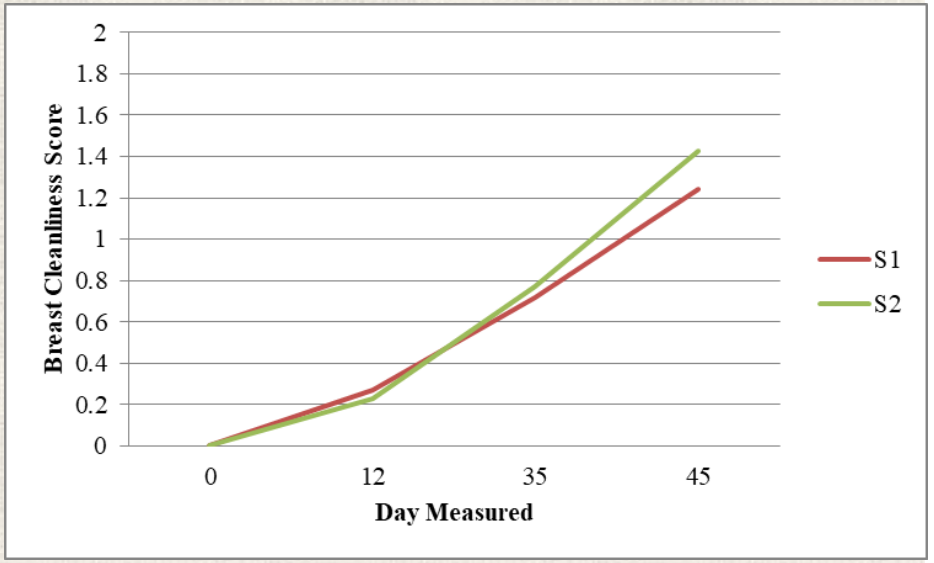
- Body Weight
- Mortality
- Footpad Scores (0-2)
- Breast Cleanliness Scores (0-2)

LITTER PARAMETERS

- Litter temperature, pH, ambient ammonia, and flux not different by treatment
  - Did differ by house
    - Temperature (°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 AND BREAST CLEANLINESS

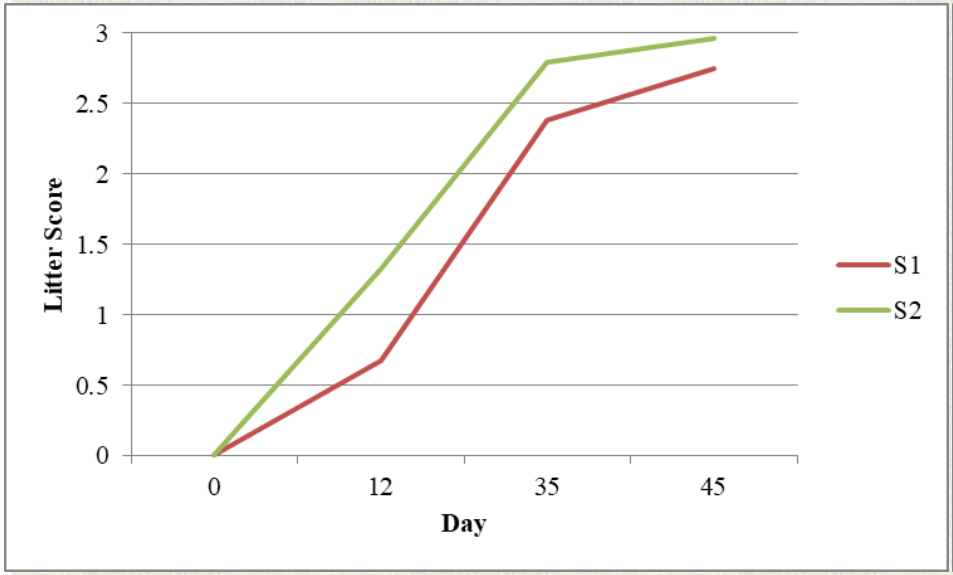


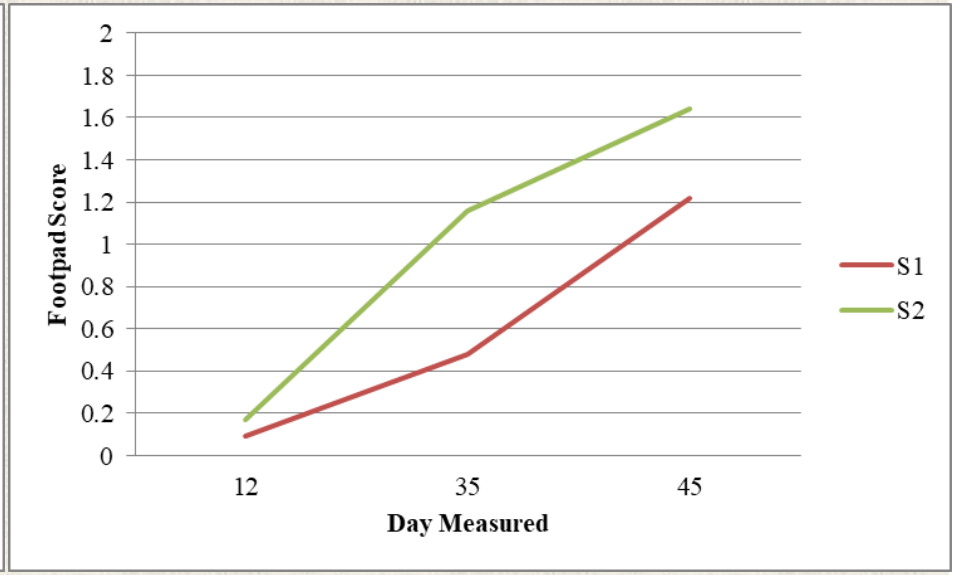


Litter Moisture				
Treatment	(n)	Day 12	Day 35	Day 45
S1	6	16.66	32.88	30.55
S2	6	17.23	33.60	33.30
P-Value	---	0.5674	0.7230	0.2981

Breast Cleanliness Scores (0-2)				
Treatment	(n)	Day 12	Day 35	Day 45
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 AND FOOTPAD SCORES





Litter Scores (0-3)				
Treatment	(n)	Day 12	Day 35	Day 45
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)				
Treatment	(n)	Day 12	Day 35	Day 45
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

LITTER NUTRIENT AND ENERGY ANALYSES

Treatment	Moisture (%)	Total N (g/kg)	NH_4 (g/kg)	Organic N (g/kg)	P_2O_5 (g/kg)	K_2O (g/kg)	Carbon (g/kg)	C:N	GJ/kg
S1	36.21	20.99	4.81	16.18	14.40	12.91[b]	273.67[a]	13.23[a]	20.05
S2	39.35	22.77	5.43	17.34	16.73	16.52[a]	247.20[b]	10.91[b]	18.08
P-value	0.1713	0.0734	0.2378	0.2072	0.0888	0.0155	0.0149	0.0257	0.0786

n=6

2.55-2.89 kg of single cycle switchgrass litter to 8.3 cm = energy in 1 L propane
(21.3-24.1 lbs of litter to 1 gallon propane)

BIRD PERFORMANCE

- Bodyweight at processing age (days 35 and 45) not significantly different between treatments
  - Bodyweight day 12
    - S2 > S1
- Overall day 1-9 mortality did not differ by treatment
  - Mortality day 1 S2 > S1

SUMMARY AND CONCLUSIONS

- Litter scores were strongly affected by treatment
  - S2 > S1
    - Footpad scores were tied to litter scores
- Breast cleanliness scores were related to litter moisture
- Bird performance was not affected by treatment
- Carbon in spent litter was highest for S1 (higher density bedding)
- Both materials are appropriate for fertilizer

Biomass Willow versus Softwood Shavings for Bedding a Single-Cycle Commercial Organic Flock

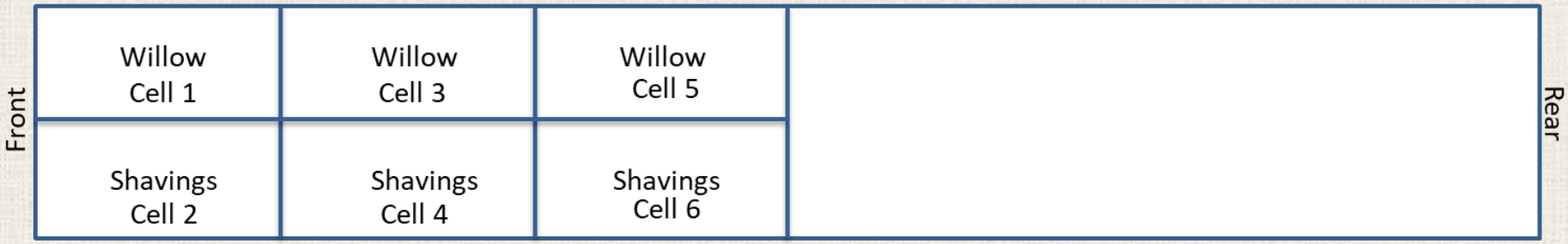
WILLOW AS A POULTRY BEDDING

- Alternative bedding replicate pen trial (Hulet et al., 2010)
  - Overall performance not affected*
  - Litter score better for willow
  - Footpad scores not affected by treatment
  - Molds and yeasts greater for birds on softwood

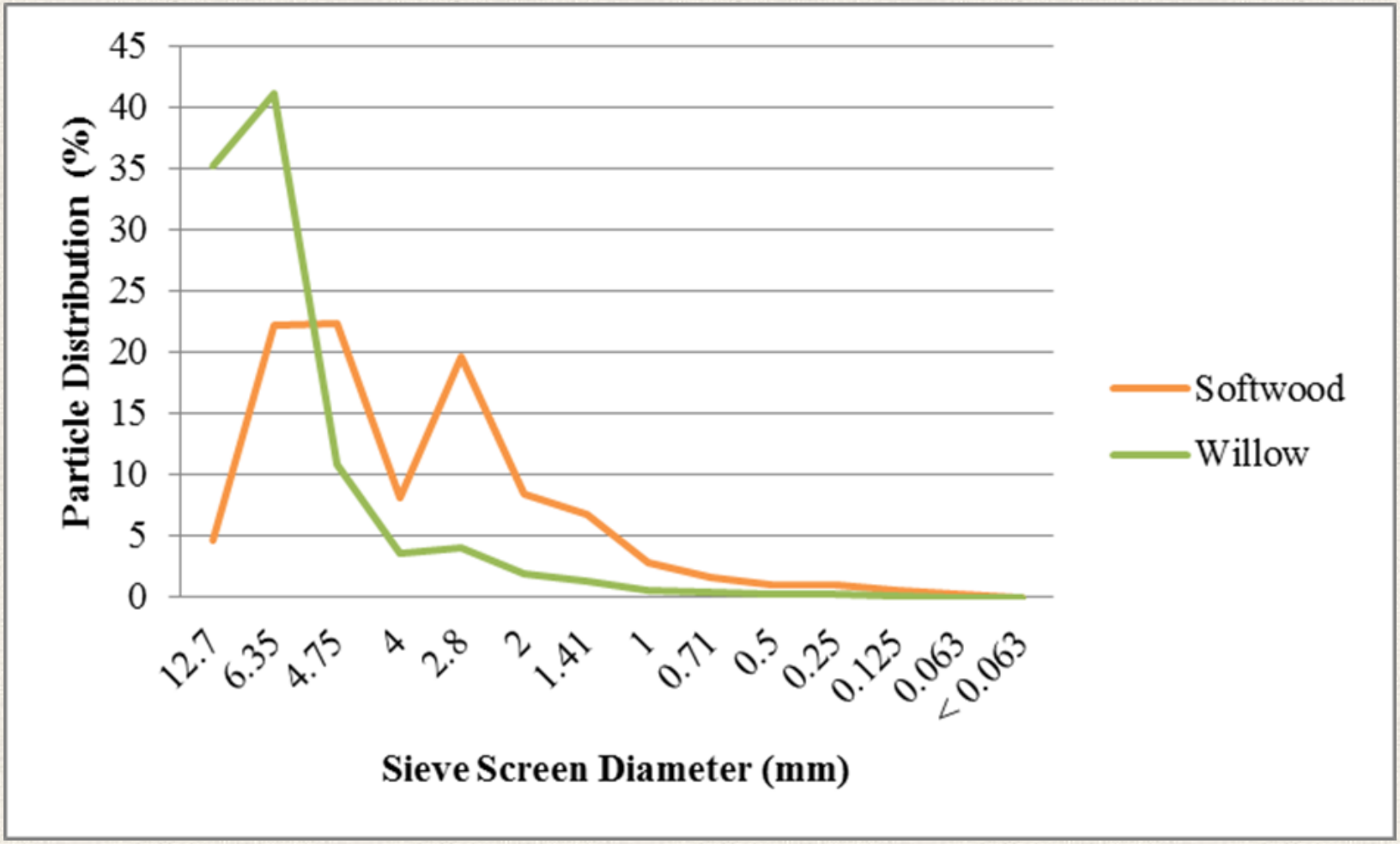
- Two replicate pen trials (Patterson et al., 2011, 2012)
  - Chopped willow vs baled softwood shavings
    - Overall bird performance/carcass yield/mortality not affected by treatment
    - Softwood shavings had worse litter scores
      - Post processing footpads better for shavings

WILLOW TRIAL DESIGN

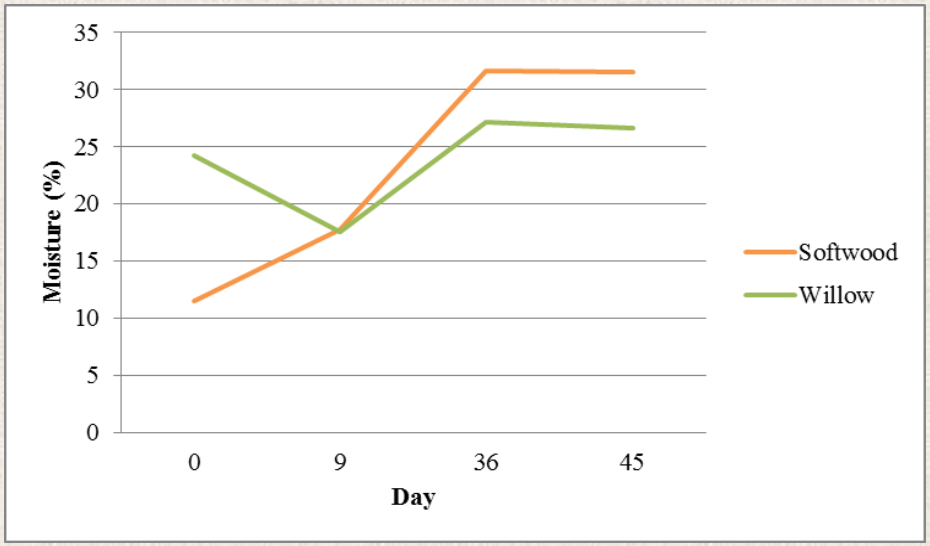
- Cooperator's farm
  - One barn with replicate pens
- White broilers (ABF stocking density)
  - 7 weeks
- April 2017 – June 2017



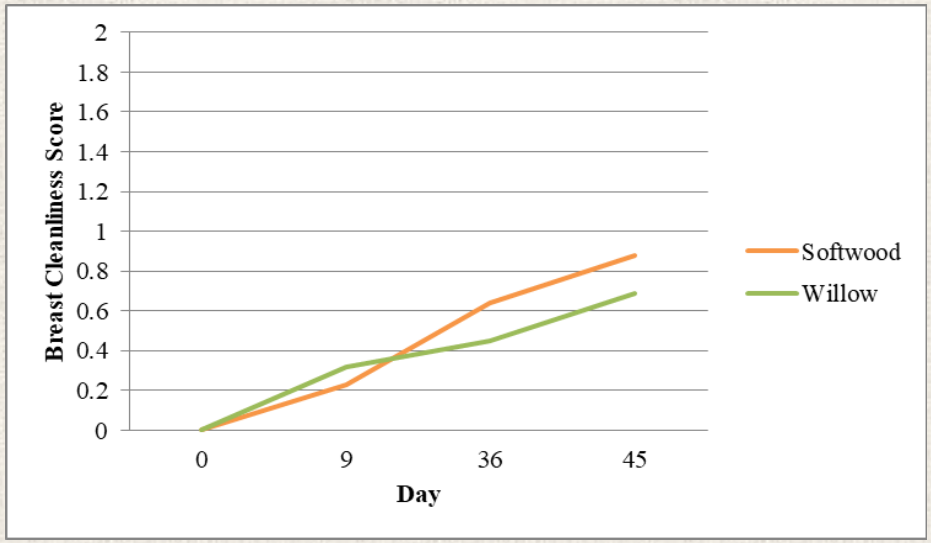
BEDDING PARTICLE DISTRIBUTION



Litter Moisture



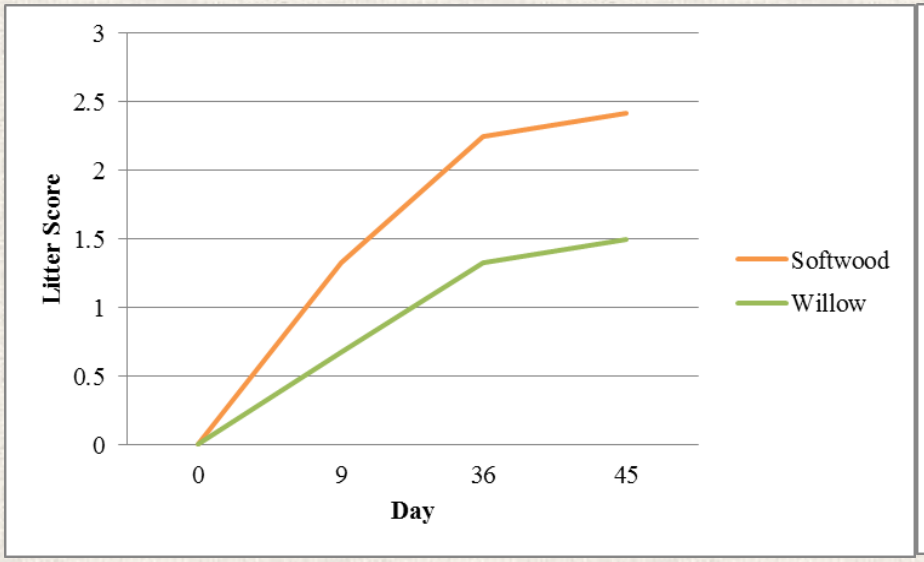
Breast Cleanliness Scores



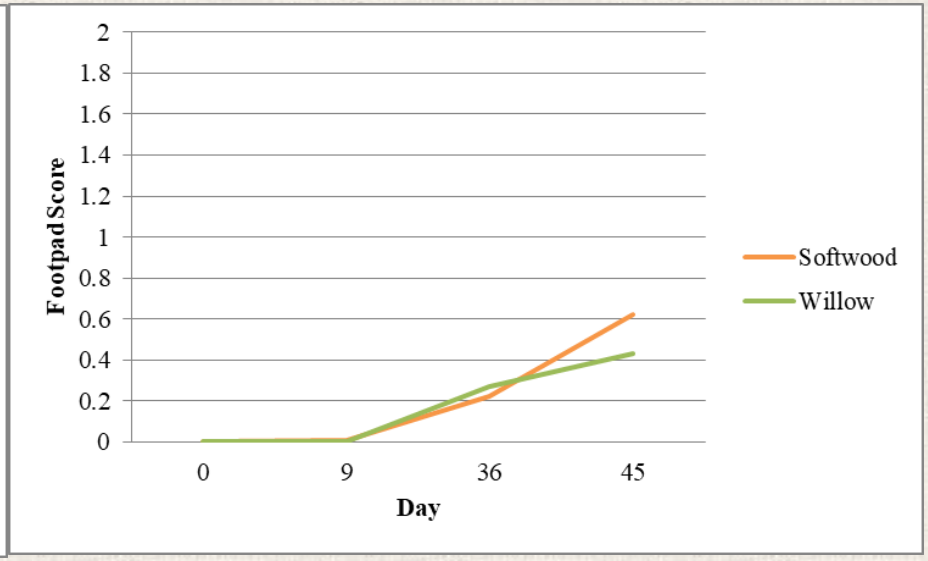
Litter Moisture				
Treatment	(n)	Day 9	Day 36	Day 45
Softwood	3	17.73	31.70[a]	31.57[a]
Willow	3	17.53	27.21[b]	26.69[b]
P-Value	---	0.7925	0.0104	0.0128

Breast Cleanliness Scores (0-2)				
Treatment	(n)	Day 9	Day 36	Day 45
Softwood	3	0.23[b]	0.64[a]	0.88[a]
Willow	3	0.32[a]	0.45[b]	0.69[b]
P-Value	---	0.0151	0.0199	0.0142

Litter Scores



Footpad Scores



Litter Scores (0-3)				
Treatment	(n)	Day 9	Day 36	Day 45
Softwood	3	1.33[a]	2.25[a]	2.42[a]
Willow	3	0.67[b]	1.33[b]	1.50[b]
P-Value	---	0.0048	0.0053	0.0053

Footpad Scores (0-2)				
Treatment	(n)	Day 9	Day 36	Day 45
Softwood	3	0.01	0.22	0.62
Willow	3	0.00	0.27	0.43
P-Value	---	0.1161	0.6495	0.3442

WILLOW VS SOFTWOOD SHAVINGS

LITTER PERFORMANCE

- Litter surface temp and pH not different among treatments
  - Ambient ammonia higher for birds on willow at day 36 (10.0 ppm vs 6.8 ppm)
    - Higher moisture for birds on softwood (31.7% vs 27.2%)
- Ammonia flux not sig different at day 45

NUTRIENT ANALYSES

Bedding

Treatment	Moisture (%)	Total N (g/kg)	NH_4 (g/kg)	Organic N (g/kg)	P_2O_5 (g/kg)	K_2O (g/kg)	Carbon (g/kg)	C:N	MJ/kg
Softwood	11.57[b]	5.17	0.94[a]	4.22	0.76	1.53[b]	441.79[a]	91.20	13.85
Willow	25.73[a]	3.97	0.17[b]	3.81	1.42	2.88[a]	362.06[b]	92.43	14.09
P-value	0.0100	0.2794	0.0014	0.6767	0.0934	0.0111	0.0020	0.9499	0.8795

n=3

Litter

Treatment	Moisture (%)	Total N (g/kg)	NH_4 (g/kg)	Organic N (g/kg)	P_2O_5 (g/kg)	K_2O (g/kg)	Carbon (g/kg)	C:N	MJ/kg
Softwood	32.00	24.15	3.61[a]	20.54	15.09	20.89	291.11	12.16[b]	11.73[b]
Willow	32.39	21.49	2.85[b]	18.63	14.27	19.20	298.79	13.78[a]	13.23[a]
P-value	0.9130	0.1042	0.0389	0.2656	0.3635	0.0943	0.6068	0.0209	0.0489

n=3

ENERGY DENSITY

2 kg of single cycle willow litter to 8.3 cm = energy in 1 L propane
(16.4 lbs of litter to 1 gallon propane)

2.2 kg of single cycle softwood litter to 8.3 cm = energy in 1 L propane
(18.4 lbs of litter to 1 gallon propane)

BIRD PERFORMANCE

- Mortality higher overall for willow d 1-9 (1.11% vs 0.73%)
- Bodyweights not affected by treatment

CONCLUSIONS

- Willow has larger particles than softwood
  - Willow kept lower litter moisture and breast cleanliness scores
  - Willow had lower litter scores overall and footpad scores
- Ammonia at d 45 not different
  - Ambient ammonia higher for softwood at d 36
    - Not influenced by litter temperature, moisture, or pH
- Bird performance not affected by treatment
- Mortality overall d 1-9 higher for willow
- Both softwood and willow can be used as fertilizer or fuel

THANK YOU!

- NE-SARE Graduate Student Grant
- Ernst Biomass
- SUNY
- Cooperating grower

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QUESTIONS?

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