

HOW PHYSICAL PROPERTIES OF BIOMASS GRASSES INFLUENCE THEIR PERFORMANCE AS A BEDDING MATERIAL FOR BROILER CHICKENS

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MATERIALS I WORK WITH



Miscanthus Grass



Switchgrass



Biomass Willow

BIOMASS



WHAT DO CHICKENS AND PLANTS HAVE IN COMMON?

- Bedding!
- Working with commercial broiler chickens
- Testing beddings at Penn State and beyond
 - Poultry Education and Research Center (PERC)
 - Local farms
- Question: How can we process biomass to make the best bedding for our chickens?



WHY USE BIOMASS AS BEDDING?

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



WHAT SHOULD A GOOD BEDDING DO?

- Wick moisture away from birds and release it
 - Low moisture over growing period
- Maintain a low pH
- Does not allow for high ammonia levels
- Not carry disease
- Not decrease bird performance
- Minimal cake
- Keep foot pads clean and undamaged
- Keep feathers clean



MEASUREMENTS WE TOOK

- Bedding: particle analyses, moisture, pH, water holding capacity, evaporative loss, density, nutrient analyses, energy densities
- Litter: moisture, pH, temperature, litter scores, ambient ammonia, ammonia flux, nutrient analyses, energy densities
- Birds: bodyweights, feed intake and conversion, foot pad scores, breast feather cleanliness scores



MATERIALS & METHODS: PARTICLE DISTRIBUTION



MATERIALS & METHODS: AMMONIA (AMBIENT AND FLUX)



Drager pull tubes



INNOVA acoustic field gas
monitor and dynamic flux
chamber



MATERIALS & METHODS: WELFARE SCORING

Foot Pad Scoring



Score = 0

Score = 1

Score = 2

Breast Cleanliness Scoring



Score = 0

Score = 1

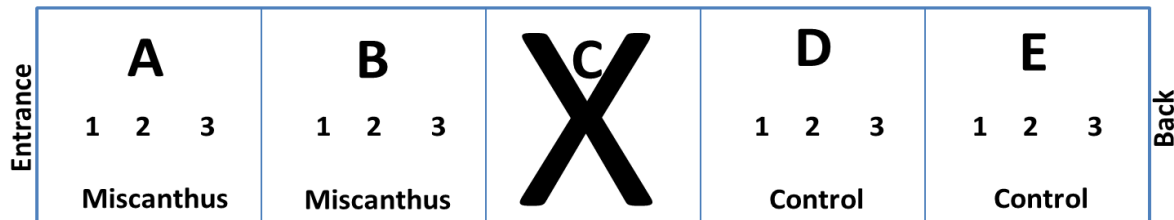
Score = 2

Procedure adapted from: 5-Step™ Animal Welfare Rating Standards for Chickens Raised for Meat. Issued October 1, 2012 v2.0 ©2012 Global Animal Partnership.

MISCANTHUS PROJECT

MISCANTHUS VS. SOFTWOOD SHAVINGS

- Cooperator's farm
- White broilers
- 5 weeks
- Conventional density (0.75 ft² per bird)
- April-June 2015



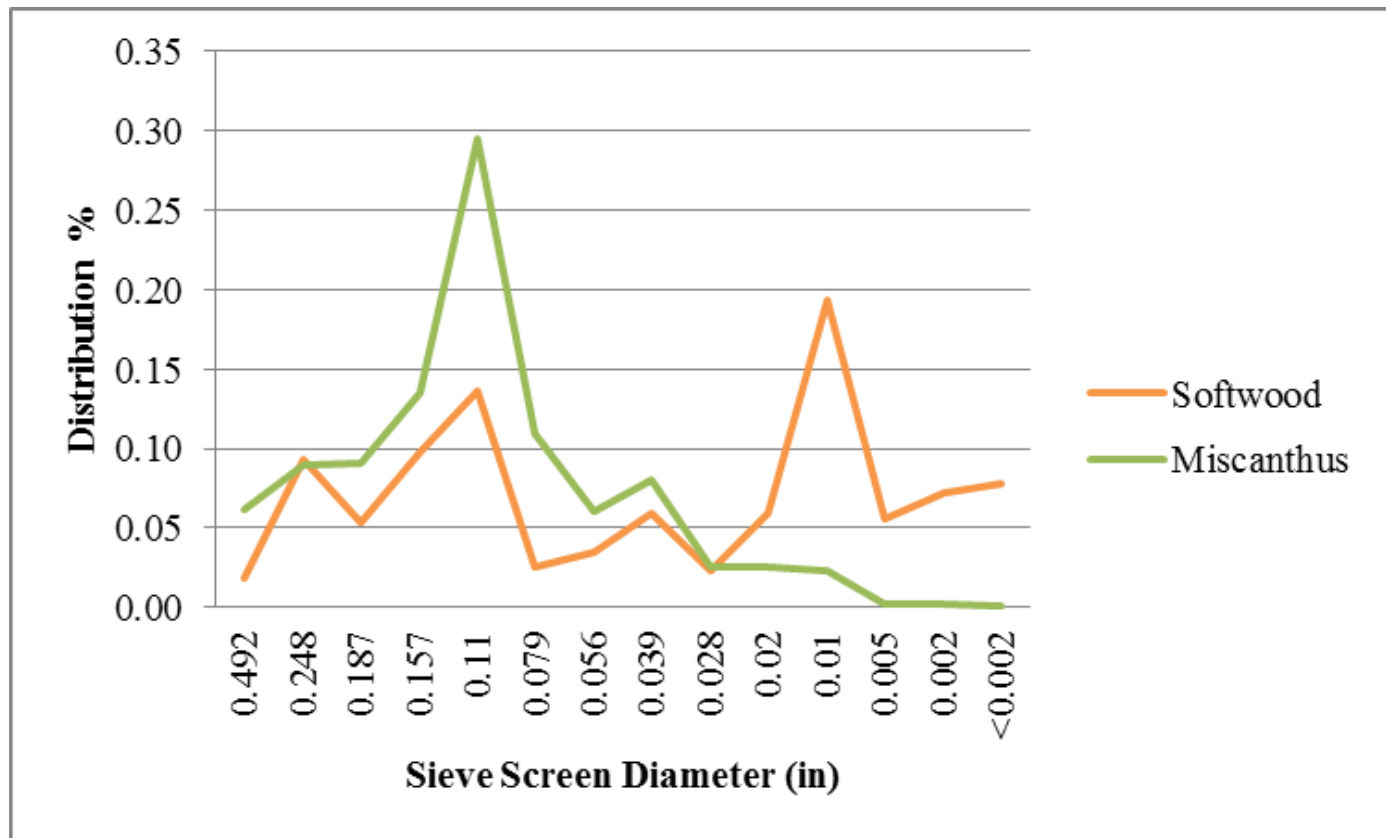
MISCANTHUS PROJECT

MISCANTHUS VS. SOFTWOOD SHAVINGS

Particles < .039”

45% Softwood Sawdust/Shavings

5.5 % Miscanthus Grass



RESULTS: LITTER AT WEEK 3



Softwood Shavings
Week 3











Miscanthus
Week 3

- Large particles migrated to surface of MG pens
- SS stayed friable



MISCANTHUS PROJECT

MISCANTHUS VS. SOFTWOOD SHAVINGS

- Held moisture 
- Low litter moisture over growing period 
- Litter surface temperature 
- Ammonia levels 
- Caking 
- Bird weights 
- Kept foot pads clean and undamaged 
- Kept feathers clean 

Key:



Worse



Same

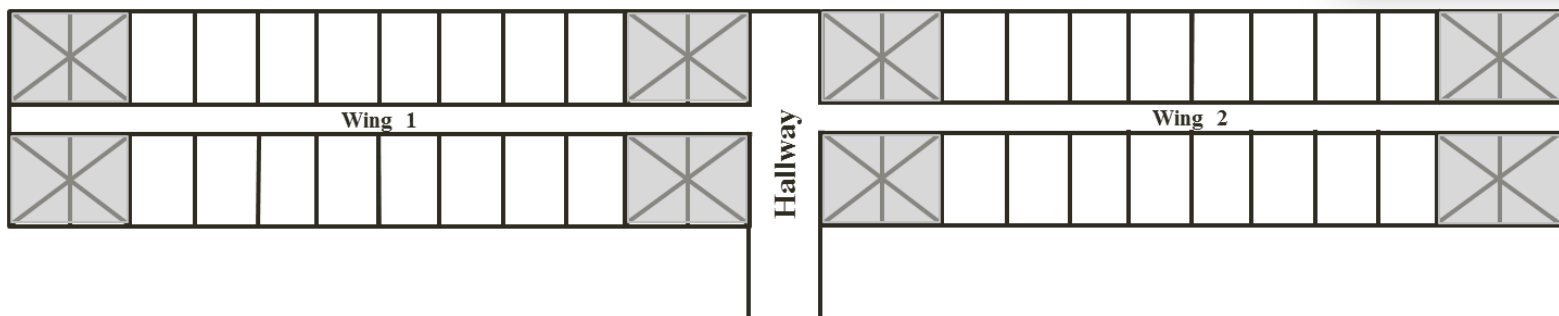


Better

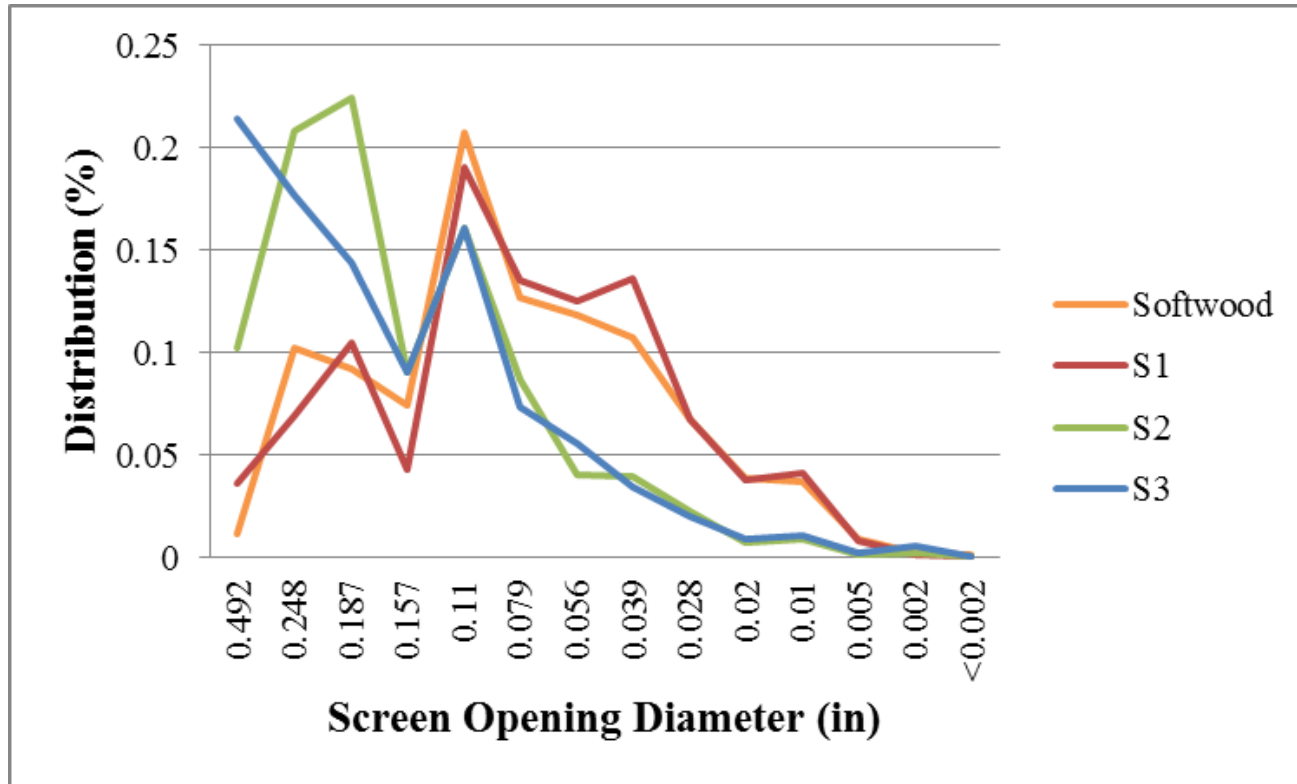


SWITCH PROJECT 1

- PSU Poultry Education and Research Center (PERC)
- Red broilers
- 8 weeks
- Organic density (1ft² per bird)
- Replicate pens
- April- June 2016



SWITCHGRASS HARVEST WITH JD 6750 FIELD HARVESTER












# Knives	Transmission Speed	Avg. Particle Size (in)	Treatment Assignment
48	1	0.21	S1
24	4	1.24	S2
12	4	2.47	S3



SWITCH PROJECT 1

SHORT (.25") VS. WOOD SHAVINGS

- Held moisture 
- Released moisture quickly to air 
 - Low litter moisture over growing period 
- Maintained a low pH 
- Ammonia levels 
- Caking 
- Bird performance 
- Kept foot pads clean and undamaged 
- Kept feathers clean 

Key:



Worse



Same















Better



SWITCH PROJECT 1

LONG (1.25"-2.5") VS. WOOD SHAVINGS

- Held moisture  
- Released moisture quickly to air 
 - Low litter moisture over growing period  
- Maintained a low pH 
- Ammonia levels 
- Caking  
- Bird performance 
- Kept foot pads clean and undamaged 
- Kept feathers clean 

Key:



Worse



Same



Better



SWITCH LITTER APPEARANCE AFTER 8 WEEKS OF USE



Control Litter Score: 1.9/3



S1 Litter Score: 1.7/3



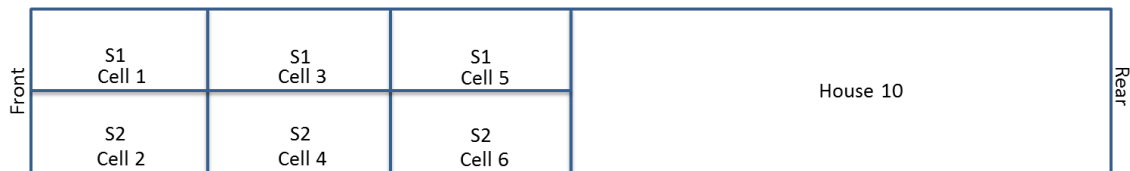
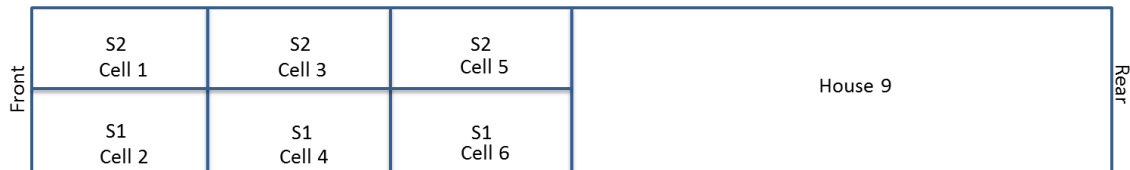
S2 Litter Score: 1.6/3



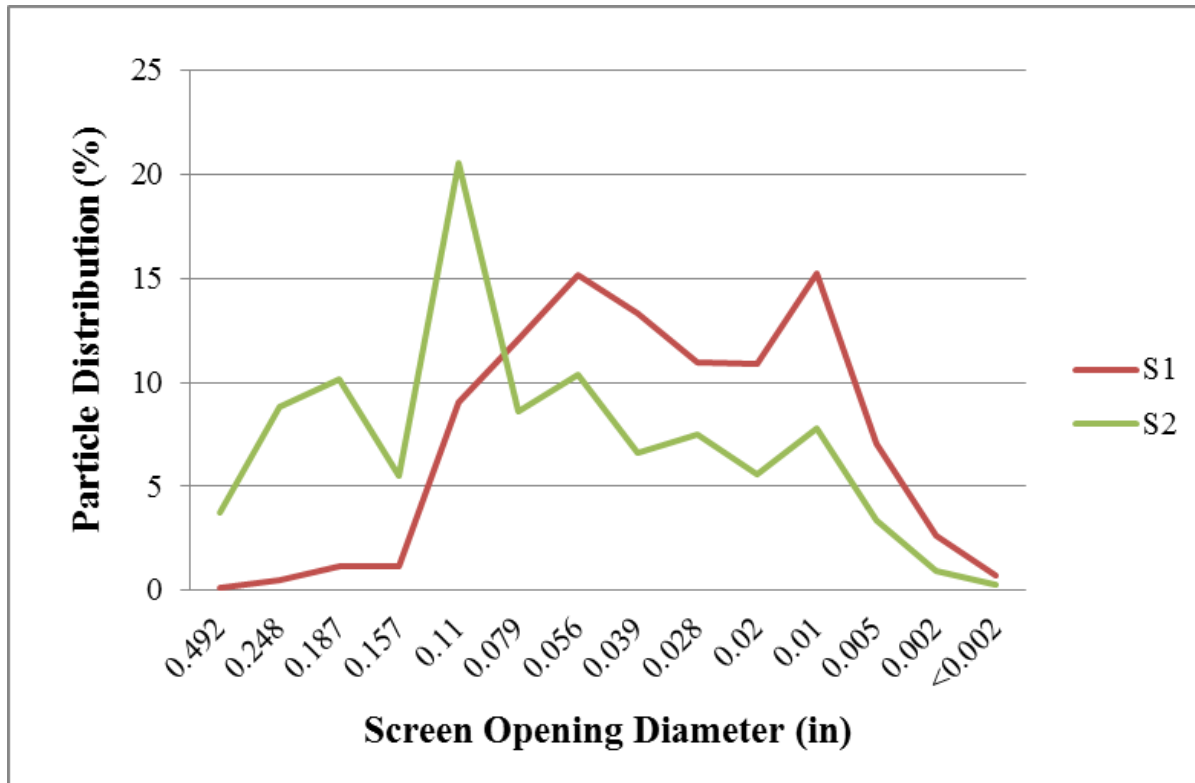
S3 Litter Score: 2/3

SWITCH PROJECT 2

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



SWITCHGRASS PROCESSED VIA TUB GRINDER



Down Screen diameter	Up Screen Diameter	Treatment
1/2"	1"	S1
1"	2"	S2



SWITCH PROJECT 2

Short
(0.5"-1")

Long
(1"-2")

- Held moisture
- Released moisture quickly to air
 - Low litter moisture over growing period
- Maintained a low pH
- Ammonia levels
- Caking
- Bird weights
- Kept foot pads clean and undamaged
- Kept feathers clean



Key:



Worse



Same



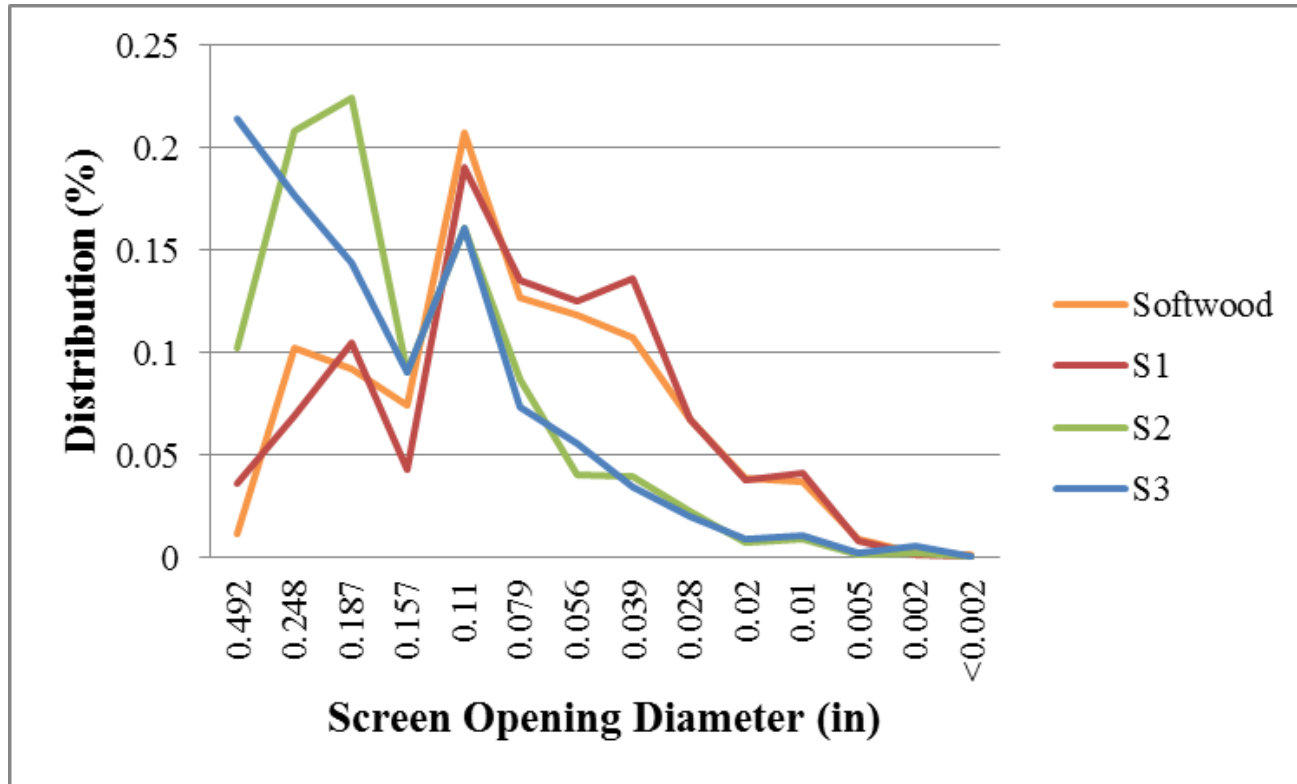
Better



SWITCHGRASS PROCESSING WITH JD 6750 FIELD HARVESTER



SWITCHGRASS HARVEST WITH JD 6750 FIELD HARVESTER



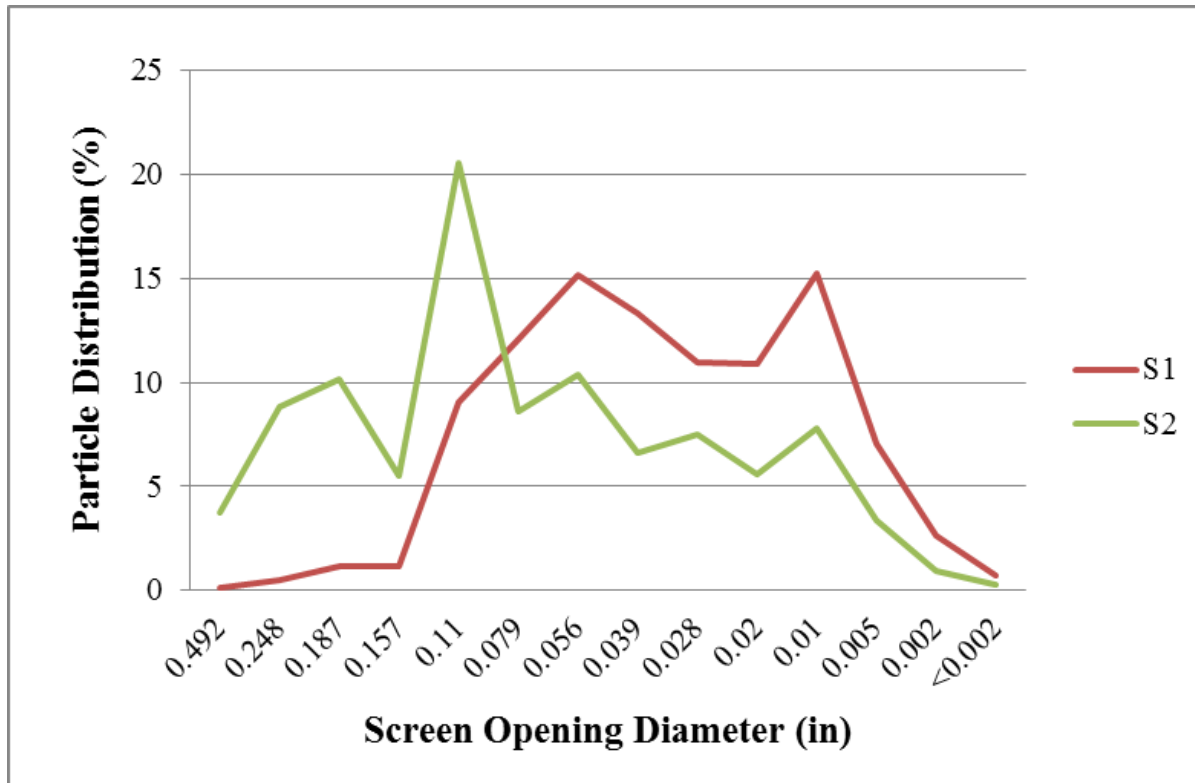
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SWITCHGRASS PROCESSED VIA TUB GRINDER



SWITCHGRASS PROCESSED VIA TUB GRINDER



Down Screen diameter	Up Screen Diameter	Treatment
1/2"	1"	S1
1"	2"	S2



SMALL FLOCK USE



Delaware County 4-H

SMALL FLOCK USE

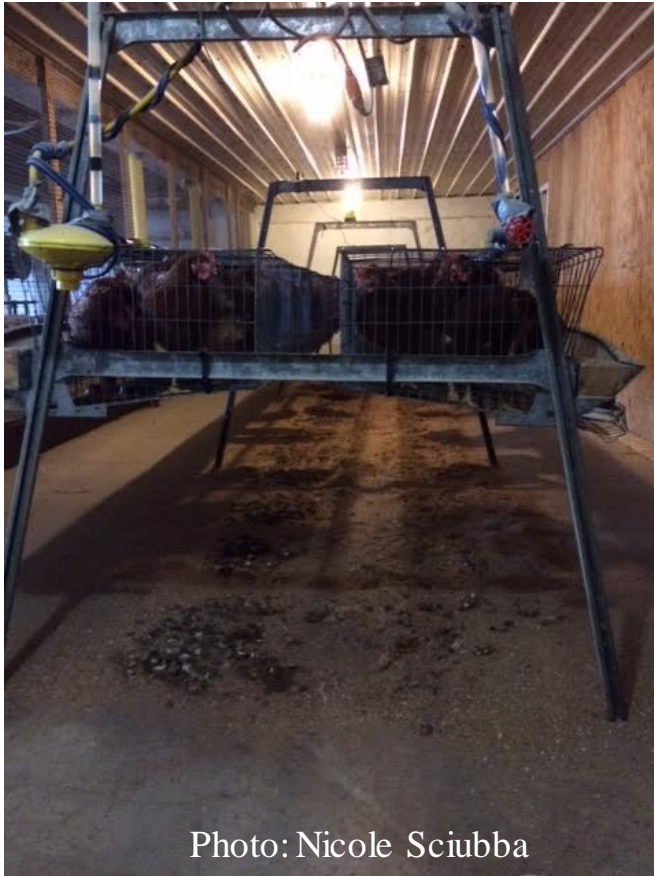


Photo: Nicole Sciubba



Photo: Nicole Sciubba

Delaware County 4-H



SMALL FLOCK USE

- Less dusty material easier to handle
 - Forage harvester, screen material
- Loose or baled product
 - Need to process bales- loose may be easier
- Expected to work similarly to shavings
- Long particles not as big of an issue
 - Due to lower stocking densities
 - Use under cages



PROCESSING CONSIDERATIONS- SWITCHGRASS

Commercial Poultry

- The smaller, the better
- Avoid particles $\geq 2\text{-}3''$
- Avoid dust, if possible
- Decrease transportation costs, where possible
- Storage considerations
 - 50' x 500' barn needs 231.5 yd³

Small Scale Flocks

- Size depends on use
 - If birds not in contact with litter, size not as important
 - If birds in contact with litter, check bird density
- Reduce dust!



WHERE TO GO FROM HERE?

- Cost and availability may be limiting factors for producers to consider alternative bedding resources
 - Increase processing and industry scale consideration
 - Economic impact
 - Purchasing locally vs grown on farm
- Energy value → carbon neutrality concept



THANK YOU TO...

- USDA
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PennState
College of
Agricultural Sciences

QUESTIONS?



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