ISSN 1682-8356
ansinet.org/ijps

INTERNATIONAL JOURNAL OF

POULTRY SCIENCE

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308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
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International Journal of Poultry Science 9 (1): 39-42, 2010
ISSN 1682-8356

Evaluation of Chopped Switchgrass as a Litter Material

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Abstract: An alternative broiler litter to pine shavings may be switchgrass, a high yielding forage crop (8-12 tons per acre) that can grow across the Southeastern U.S. A study was conducted to determine the efficacy of chopped switchgrass as a litter material for broiler chickens. Pine Shavings (PS) and Switchgrass (SG) were used as litter treatments with 10 replications each. Body weight, body weight gain, feed consumption, feed conversion, carcass weights and mortality were not different between treatments. However, the incidence of foot pad dermatitis was significantly decreased with SG litter. Live performance and carcass weights were not affected by using chopped SG as a litter material when rearing broilers over a short duration (one flock cycle).

Key words: Alternative litter, chopped grass, broiler

INTRODUCTION

Bedding material (litter) for broiler production has become increasingly expensive and difficult to obtain. Pine Shavings (PS) have been the preferred material for broiler production in the Southeastern U.S. for many years. Many alternative materials have been evaluated for litter ranging from wood by-products to waste materials (Grimes *et al*., 2002). Carter *et al*. (1979) found green pine and hardwood chips resulted in slightly higher breast blisters as compared to dry pine shavings. Others studied softwood chipping fines (Parsons and Baker, 1985) and hardwood bark (Brake *et al*., 1992) with good results.

Paper products from industrial and municipal waste streams is readily available and have been evaluated as potential sources of litter material. Researchers have compared shredded newspaper, processed newspaper (Malone *et al*., 1982), mixtures of shredded newspaper and wood shavings (Burke *et al*., 1993), recycled paper chips (Lien *et al*., 1992), pelleted newspaper (Malone and Gedamu, 1995) and chopped computer and bond paper mixed with pine shavings (Martinez and Gernat, 1995) with equal or better results to pine shavings. Issues of breast blisters were observed with processed cardboard by (Malone *et al*., 1982) and the use of adhesives in pelleted newspaper resulted in increased caking (Malone and Gedamu, 1995). Malone *et al*. (1983) found that broilers reared on cellulose fiber Composted Municipal Garbage (CMG) had improved body weights and feed efficiency compared to pine shavings, but the presence of heavy metals in CMG may limit its application as bedding material. More recently, Grimes *et al*. (2007) tested a composite material, aGroChips, made from cotton lint waste, gypsum and newspaper in rearing turkeys resulting in heavier birds when compared to pine shavings though there were issues with crusting.

Sand has been considered an alternative litter material in the southern part of the United States (Grimes *et al*., 2002). Bilgili *et al*. (1999) reported increased body weights and lower coliform and aerobic plate counts for sand as compared to pine shavings. Sand has had performance and mortality benefits but may not be economical for all producers. Sand is not compatible with composting, combustion, or pelleting (Grimes *et al*., 2002).

Cereal crop residues have provided several reliable litter alternatives. Veltmann *et al*. (1984) concluded that rice hull products (whole rice hulls, ground rice hulls and rice hulls plus wood shavings) were a suitable bedding material for turkey poults. More recently Chamblee and Yeatman (2003) evaluated rice hull ash and a blend of ash and wood shavings with no consistent differences in body weight, feed conversion, ammonia, nitrogen, phosphate or potash between treatments. Lien *et al*. (1998) reared broiler breeder pullets on peanut hulls with no litter affect on bird performance and mortality. Chopped corn cobs and stover are normally used in areas where large quantities of corn is produced (Grimes *et al*., 2002). Other plant residues have been studied including whole chopped kenaf and kenaf core (Malone *et al*., 1990; Brake *et al*., 1993), bagasse

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(Malone, 1992) and leaves (Willis *et al*., 1997). Many of these materials are linked to specific regions and harvesting seasons and like sand, may be uneconomical for many growers due to transportation costs or storage issues.

Grass and cereal grain straw have been utilized as a litter material with wheat straw being the most common. Chaloupka *et al*. (1967) found that chopped barley straw had no adverse effects on performance or mortality. Nakaue *et al*. (1978) compared chopped wheat straw, a mixture of straw and wood shavings and shavings at varying stocking densities. The straw was chopped to 5 cm (1.96 in) in length and was comparable to shavings in bird performance and ammonia levels. Nakaue *et al*. (1978) determined that straw held 3.5 times the water of shavings and caked more at stocking densities less than 0.009 m^2 (0.75 ft^2). More recently, Smith (2002) compared chopped bermuda grass hay against pine shavings for use in rearing hen turkeys and found no differences in live performance or litter condition. Smith (2002) unrolled 362-454 kg (800-1000 lb) bales and chopped the hay to 1.27-2.54 cm (0.5-1.0 in) in length using a silage cutter.

Availability of wood products and by-products such as wood chips, saw dust and wood shavings will continue to decline as production of lignocellulosic-based biofuel production processes expand and these materials are diverted for use as biofuels feedstock. This increased demand will likely make use of traditional wood-based litter materials economically unfeasible for poultry producers and alternative sustainable sources of litter material must be identified. An alternative is *Panicum virgatum*, more commonly known as switchgrass. Switchgrass is a high yielding forage crop (8-12 tons per acre) that can grow across the Southeastern U.S. The objective of this study was to compare chopped Switchgrass (SG) to Pine Shavings (PS) as a broiler litter material.

MATERIALS AND METHODS

Husbandry procedures: A total of 400 Ross x Ross 708 chicks were obtained from a commercial hatchery. Chicks were sexed (50% male and 50% female) and randomly distributed among 20 floor pens measuring 1.2 m x 1.5 m (4 ft x 5 ft) at 11.1 birds/m^2 (1 bird/ft^2) in a tunnel-ventilated research facility. Each pen was equipped with a tube feeder and a nipple drinker line; feed and water were available ad libitum. Air temperature was maintained at 33°C and reduced as birds aged to a final temperature of 21°C. A four-phase feeding program was used, composed of a starter (1-14 d), grower (15-28), finisher (29-41) and withdrawal (42-49); all diets were formulated to meet or exceed NRC (1994) recommendations.

Treatments: Two litter materials, pine shavings and chopped switchgrass, were compared in this study. Pine shavings were obtained from a commercial sawmill. Switchgrass bales were obtained from research plots at the Mississippi State University Bearden Dairy Research Center. Bales were chopped in a hammer-mill using a 0.64 cm (1/4 inch) screen. Ten replicate pens containing each litter material were used. Litter material was placed in the pens at a depth of 8.9 cm (3.5 in).

Measurements: Birds and feed were weighed for each pen at 14, 28, 42 and 49 d of age to determine growth rate, feed consumption and feed conversion. The incidence of mortality was recorded daily. At 49 d of age, 10 birds (5 males + 5 females) were selected randomly from each pen for processing to obtain carcass weights and foot pad scores. Foot pad scores were assigned according to the following scale: 1 = no visible lesions, 2 = lesion with area < 1.5 cm and 3 = lesions with area > 1.5 cm.

Statistical analysis: This trial was conducted as a completely randomized design with 10 replicate pens and two litter type treatments. Data were analyzed with an ANOVA and means were separated using Fisher's LSD (Ott and Longnecker, 2009). Analyses were performed by PROC MIXED (SAS Institute, 2004). All mortality data were subjected to arc sine transformation. Statistical significance was established at $p \leq 0.05$.

RESULTS

Live performance parameters including Body Weight (BW), Body Weight Gain (BWG), Feed Consumption (FC) and Feed Conversion (FG) were compared for each litter material type and are shown in Table 1. No significant differences were observed between litter types for any live performance parameter. Mortality for PS and SG for the study period was 1.5 and 2.5%; mortality was not significantly different between treatments. All birds were processed at 49 d to determine carcass yield and foot pad scores. Carcass weights for PS (2376±21 g) and SG (2384±20 g) were not significantly different. Mean foot pad scores (PS = 1.39±0.03 and SG = 1.30±0.03) were significantly different between litter material types ($p \leq 0.0281$) and distribution of foot pad scores for each treatment is shown in Fig. 1.

DISCUSSION

Data for poultry reared on chopped grass hay litter material is limited. Smith (2002) compared PS, chopped bermuda grass hay and a mixture (1:1) of PS and hay for use as litter material for turkey hens; BW and FG were similar for all litter materials. Numerous studies have evaluated chopped straw (typically wheat straw) as a litter material for commercial poultry production (Chaloupka *et al*., 1967; Nakaue *et al*., 1978; Malone, 1992; Bilgili *et al*., 2009; Torok *et al*., 2009). Nakaue *et al*.

Table 1: Live performance responses from placement for broilers reared on two different litter types[1]

		PS[3]		SG[4]	
Age	Parameter[2]	Mean	SEM	Mean	SEM
0-14 d	BW (g)	448	6	450	3
	BWG (g)	401	6	408	3
	FC (g)	534	8	528	5
	FG	1.309	0.020	1.294	0.021
15-28 d	BW (g)	1531	13	1532	6
	BWG (g)	1479	13	1474	17
	FC (g)	1612	13	1613	10
	FG	1.439	0.002	1.435	0.004
29-41 d	BW (g)	2744	21	2738	24
	BWG (g)	2699	21	2681	22
	FC (g)	2286	21	2305	20
	FG	1.641	0.005	1.646	0.007
42-49 d	BW (g)	3368	24	3374	27
	BWG (g)	3324	24	3296	33
	FC (g)	1433	13	1452	19
	FG	1.764	0.007	1.778	0.006

[1]Values represent the mean of 10 replicate pens. [2]Performance parameters include: mean Body Weight (BW), Body Weight Gain (BWG), Feed Consumption (FC) and Feed Conversion (FG). [3]Pine Shavings (PS) used as litter material. Litter material was filled to a depth of 8.9 cm in a floor pen measuring 1.2 m x 1.5 m. [4]Chopped Switchgrass (SG) used as litter material. Litter material was filled to a depth of 8.9 cm in a floor pen measuring 1.2 m x 1.5 m

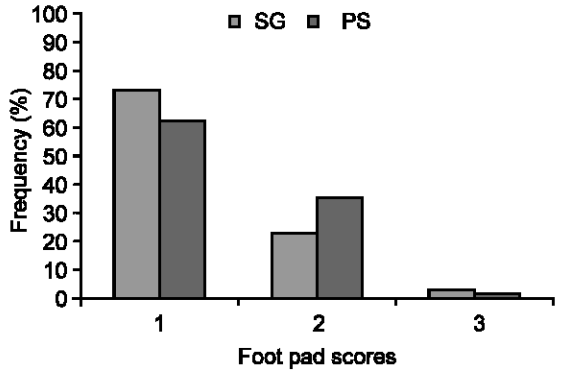

Fig. 1: Frequency of foot pad lesion scores for each litter material treatment (PS = Pine Shavings, SG = Chopped Switchgrass, Total = study totals)

(1978) reported that BW, FG, breast blisters and air quality parameters (dust and ammonia) were similar for chopped straw and wood shavings. Most recently, Bilgili *et al.* (2009) compared live performance for differing litter materials including chopped wheat straw and PS and found no differences in live performance (BW, FG and mortality) attributable to litter material type. Live performance (BW, FG and mortality) and carcass weights were similar for both PS and SG in the current study, similar to the results reported for turkey hens reared on chopped bermuda grass hay and on broiler reared on wheat straw.

Bilgili *et al.* (2009) evaluated eight different litter materials to determine their effects on incidence and severity of foot pad dermatitis, including chopped wheat straw. Birds reared on chopped straw showed a higher incidence and severity of FPD when compared to PS in two of three trials. Smith (2002) found no differences in FPS when comparing chopped bermuda grass hay to PS. Results of the current study show a statistically significant improvement in mean FPS ($p \leq 0.0281$) for chopped SG material; however these results are based only on one flock cycle and further studies are needed to determine the effects of using SG material as litter over multiple flocks on the incidence of FPD.

With the results reported here and by Smith (2002), it is reasonable to conclude that chopped grass hays are suitable as litter material for a single flock cycle. Availability of traditional wood-based litter materials like PS will continue to decline as production of lignocellulosic-based biofuels expands and PS are diverted to feedstock. The bulk density of the material used in this study was 143.8 kg/m^3 (8.98 lb/ft^3) loose packed and filling a typical tunnel ventilated house in the U.S. measuring 12.2 m wide x 152.4 m long (40 ft x 500 ft) would require 2.64 tonne/cm depth (2.9 ton/in depth) of chopped SG material. Assuming switchgrass yields of 17.9 tonne/ha (8 ton/acre) in Mississippi, 0.15 ha/cm litter depth (0.94 acre/in depth) would be required. Thus, 1.3 ha (3.3 acre) would be required to fill a house to a depth of 8.9 cm (3.5 in).

Conclusion: Live performance and carcass weights were not affected by using chopped SG as a litter material when rearing broilers over a short duration (one flock cycle). The incidence of FPD was significantly decreased with SG litter. As availability of traditional litter materials declines, SG based litter material may be a viable alternative to replace PS. Further work is necessary to evaluate production and litter nutrient responses and durability over successive flocks.

ACKNOWLEDGEMENTS

The authors thank D. Chamblee, M. Robinson, W. Massey and W. Lowe for their contributions to this study. Materials provided in part by the Mississippi State University Sustainable Energy Research Center (SERC).

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Approved for publication as Journal Article No. J-42288 of the Mississippi Agricultural and Forestry Experiment Station, Mississippi State University, Mississippi State, USA.