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# Chopped Willamette Valley Grass Seed Straw as Alternative Litter for Broiler Production

*Harry Nakaue and J.C. Hermes*  
*Department of Animal Sciences*  
*Oregon State University*

## Summary

Four experiments were conducted during spring, late fall, and winter seasons using commercial broilers to investigate the suitability of different types of chopped Willamette Valley grass seed straw as litter for broiler production. Chopped annual rye grass straw and pelleted rye grass straw are more suitable litter than chopped rye grass, fescue, and orchard grass straws.

Body weights of broilers reared on chopped annual rye grass straw with stocking densities of .044, .061, and .074 m<sup>2</sup>/broiler were not different; however, feed conversions were better ( $P < .05$ ) for broilers reared at .044 and .061 densities than at .074 density. Litter caking scores were higher ( $P < .05$ ) as the stocking densities were increased from .074 to .044 starting at 2 weeks.

Flail mower-chopped perennial rye grass straw had less litter caking than machine-sliced perennial rye grass straw.

Chopped annual rye grass straw proved to be the better litter material for broiler production when compared to the other straw types at a broiler stocking density of 074 m<sup>2</sup>.

(Key words: broiler litter, straw litter, broiler stocking density)

## Introduction

Broiler chickens are reared exclusively on litter floors by the United States poultry industry. Proper bedding or litter material placed on the floor in broiler houses is an essential item in broiler production. Traditional broiler litter materials are usually the by-products of local industries. Sawdust and wood shavings, timber by-products in the

Northwest, are becoming increasingly scarce and expensive. In order to overcome these difficulties, broiler producers reuse their litter several times, which can lead to managerial problems such as poor house environment, increased incidences of disease, and reduced bird performance. A number of alternative litter sources have been investigated for broiler production--paper mill by-products (Cottier, 1973); composted broiler litter (Dorminey and Weswig, 1973); peanut hulls (Ruszler and Carson, 1968; Chaloupka *et al.*, 1967; Rives, 1991); cane pomace (Ruszler and Carson, 1968); ground corn cobs, peat moss, cocoa bean shells, ground polystyrene, chopped barley straw (Chaloupka, *et al.*, 1967); Kenaf core particle (Malone *et al.*, 1990); shredded newspaper (Burke *et al.*, 1992); heavy and coarse paper (Rives, 1991); chopped cereal straw (Nakaue *et al.*, 1978); and wood fiber pellets (Modhish, 1987). The limiting factor influencing the use of these alternative litter sources is a readily available, inexpensive supply.

Pacific Northwest broiler producers depend on sawdust and wood shavings as litter materials. However, competition for these litter sources from the horticultural industries, incentives to use these by-products for value-added products such as particle board, and the limited supply and increased costs of these wood by-products caused by limited logging of Pacific Northwest forests in the last few years all have prompted broiler producers to seek alternative litter sources such as grass seed straw.

Approximately 100 million kilograms (1 to 1.2 million tons) of grass seed straw are produced in Oregon's Willamette Valley annually (Miles, personal communication). Unlike other alternative litter materials, supply is virtually unlimited. Therefore, four experiments were conducted to investigate the suitability of various types of chopped Willamette Valley grass seed straws as a litter material for broiler production.

## Materials and Methods

### General Procedure

Commercial straight-run broiler strain cross chicks were reared using the same brooding and rearing methods during each of the four experiments. Infra-red heat lamps were used as the heat source throughout the experiments. Continuous (24 hr/day) artificial lighting (5.38 lux) was provided throughout each experiment with incandescent light bulbs (40 watts) 2.44 m (8 ft) above the floor. Identical broiler starter and grower-finisher mash feeds were fed *ad libitum* during each experiment from day-old to 3 weeks, and from 3 to 7 weeks of age, respectively. Water was provided *ad libitum* via dome hanging waterers (30.5 cm dia/waterer). The experiments were carried out on concrete floor pens in an uninsulated, naturally ventilated house. Males and females were weighed separately by pen, and feed consumption for each pen was obtained at the end of each experiment (6 or 7 weeks of age). Litter caking, which causes severe management and disease problems, was scored and recorded by four individuals to reduce individual biases. Litter caking was scored on the scales of 0, 1, 2, 3, and 4, with no caking, 1/4, 1/2, 3/4, and fully caked pens, respectively. Mortality was recorded daily as it occurred during each experiment.

### Experiment 1

This experiment was conducted from early December to late January. A total of 1,920 commercial broiler chicks were utilized in this 7-week experiment to compare the suitability of chopped annual rye grass, perennial rye grass, fescue, orchard grass, pelleted rye grass straw, and wood shavings as litter/bedding material for broiler production. The straw types were chopped with a tub grinder to approximately 5 cm in length. Pelleted rye

grass straw (.32 cm dia.) was purchased from a local straw-pellet manufacturer. Each chopped straw type was placed in four pens (2.44 m x 3.05 m/pen), and each pen served as a replicate. Straw types and wood shavings were placed at depths ranging from 5.1 cm to 7.6 cm. Fir wood shavings served as the control litter. Broiler stocking density for each pen was .074 m<sup>2</sup> per chick (13 broilers/m<sup>2</sup>).

## **Experiment 2**

In this experiment, conducted from early February to late March, 780 commercial broiler chicks were placed in 16 floor pens (1.22 m x 3.05 m/pen) to compare the effect of broiler stocking densities and chopped annual rye grass straw bedding/litter on 7-week broiler performance and litter caking. Stocking densities of .044, .061, and .074 m<sup>2</sup> per bird for the chopped rye grass straw and .074 m<sup>2</sup> for the fir wood shavings (control) were accomplished by placing different numbers of chicks in each pen. Each stocking density was replicated in four pens. Chopped annual rye grass seed straw (from 2.54 to 5.08 cm long) and wood shavings were placed in each pen ranging from 5.1 cm to 7.6 cm deep. In addition, incidences of foot pad dermatitis and leg abnormalities for each broiler were examined and recorded at the end of the experiment (7 weeks of age). Any lesions on the foot pad were considered as dermatitis. Crooked legs or toes were considered as leg abnormalities.

## **Experiment 3**

This experiment was conducted from early April to late May. A total of 1,600 commercial broiler chicks were reared on machine-sliced fine fescue straw and perennial rye grass straw, flail mower chopped perennial rye grass straw, and fir wood shavings in sixteen

pens (2.44 m x 3.05 m/pen) to 6 weeks of age to compare bird performance and litter caking. Machine-sliced straw types were 5 cm long with the fines screened out. The flail-mower perennial rye grass straw was from 5 cm to 10 cm long. Straw types and wood shavings were placed in four pens per litter type to depths ranging from 5.1 to 7.6 cm with fir wood shavings serving as the control group. Broiler stocking density was .074 m<sup>2</sup> per broiler.

#### **Experiment 4**

The fourth experiment conducted from late October to early December, included 2,400 commercial female broiler chicks reared from day-old to 6 weeks of age in larger pens (4.88 m x 4.88 m/pen) to compare the suitability of chopped annual rye grass straw (5.1 cm to 7.6 cm long) and wood shavings as broiler litter material. Each litter type was placed in four pens for replication. The floors of the pens were covered with each litter material to depths ranging from 5.1 to 7.6 cm. Wood shavings served as the control litter. The broiler stocking density was .079 m<sup>2</sup> per broiler.

#### **Statistical Analysis**

Each experiment was a randomized block design with equal numbers of replicates for each litter material assigned to each block. The main effects were the litter types or bird densities. The experimental unit was the individual pens. The data were analyzed by one-way analysis of variances using the SAS<sup>®</sup> General Linear Model procedure (SAS Institute, 1988). Percent mortality data were converted to arc sine prior to analysis. Significant treatments were separated by least significant differences (Steel and Torrie, 1980), with probability levels as indicated.



## Results and Discussion

### Experiment 1

Experiment 1 was designed to investigate the suitability of chopped annual rye grass (CRGS), perennial rye grass, fescue and orchard grass, and pelleted rye grass straw as litter for broiler production. Performance data and weekly litter-manure caking scores are presented in Tables 1 and 2, respectively. No differences ( $P > .05$ ) in male body weight, feed conversion, or mortality were observed among the straw types at 7 weeks of age (Table 1). However, females reared on pelleted rye grass straw were heavier ( $P < .1$ ) than females reared on chopped fescue, orchard grass, and CRGS (Table 1). Overall body weight of the combined sexes for the broilers reared on pelleted rye grass straw was better ( $P < .1$ ) than the combined sex body weights for the CRGS litter (Table 1). Possibly broilers reared on pelleted rye grass straw may have consumed some of the pellets, which may have contributed to the better growth.

Caked litter can serve as a predisposing factor to disease and carcass downgrades due to higher incidences of breast blisters. Litter caking scores at 2 weeks of age were higher ( $P < .05$ ) for CRGS, fescue, and orchard grass straw than wood shavings (control) and pelleted rye grass litter (Table 2). Litter caking scores were higher ( $P < .05$ ) with CRGS than wood shavings from 2 to 6 weeks of production (Table 2). Wood shavings and pelleted rye grass straw were comparable in the litter caking scores through 7 weeks of production. At 7 weeks, litter caking scores were identical among the litter types. Pelleted rye grass straw seems to be a feasible litter source; however, it is more expensive than the chopped rye grass straw. Also, the pellets disintegrated to fine particles by the fourth week of production.

## Experiment 2

The 7-week data on broiler performance, litter caking scores, and observations of leg disorders with varied stocking densities of Experiment 2 are presented in Tables 3, 4, and 5, respectively. No differences ( $P > .05$ ) in male or combined sex body weights and mortality were observed among the stocking densities (Table 3). Females reared on CRGS with .044 stocking density weighed less ( $P < .05$ ) than females reared with .061 or .074 stocking densities. At .074 stocking density, females reared on wood shavings were heavier ( $P < .05$ ) than females reared on CRGS (Table 3).

Feed conversions for broilers reared on CRGS at .044 and .061 stocking densities were better ( $P < .05$ ) than at .074 density (Table 3). These differences may be attributed to less feed consumption and more efficient feed utilization by the broilers reared in higher stocking densities. No difference in feed conversion was observed between broilers reared on CRGS and wood shavings at .074 stocking density.

Litter caking scores were higher ( $P < .05$ ) as the stocking densities were increased from .074 to .044 on CRGS, starting at 2 weeks (Table 4). At .074 stocking density, litter caking scores were the same ( $P > .05$ ) for CRGS and wood shavings to 6 weeks. However, at 7 weeks, caked litter score was higher ( $P < .05$ ) for CRGS than the wood shavings at .074 density.

There was an increase of foot pad dermatitis as the stocking density was increased from .074 to .044 on CRGS; however, more incidences of dermatitis were observed on wood shavings than CRGS at .074 stocking density (Table 5). High stocking densities led to more litter caking and subsequently more foot pad dermatitis. The incidences of leg disorders such as crooked legs or toes did not increase as the stocking density increased. These disorders may be related to genetics of the broiler strain utilized.

### Experiment 3

Various methods of slicing or chopping straw were investigated in Experiment 3. No differences ( $P > .05$ ) in body weight, feed conversion, and mortality were observed among the machine-slicing and flail-mower chopping methods of the three types of straw (Table 6).

Litter caking scores were higher ( $P < .05$ ) for the machine-sliced fine fescue straw and flail-mower chopped perennial rye grass straw than for sliced perennial rye grass straw and wood shavings from 2 to 5 weeks (Table 7). No differences in caking scores were observed at 6 weeks between machine sliced and flail mower chopped grasses and wood shavings. As expected, since the flail-mower chopped straw was longer (10 cm long) more litter caking occurred. The fine fescue straw has smaller stems than the perennial rye grass straw, which could be the reason for more litter caking with the fine fescue straw. Sliced perennial rye grass straw seems to be a better litter than sliced fine fescue straw and flail-mower chopped perennial rye straw litter based on the caking scores.

### Experiment 4

Experiment 4 was carried out in larger floor pens (4.88 m x 4.88 m/pen) to simulate a field trial. Wood shavings and chopped annual rye grass straw were compared. No differences ( $P > .05$ ) in body weight, feed conversion, mortality, and litter caking scores were observed with broilers reared on wood shavings compared to chopped annual rye grass straw (Tables 8 and 9).

Willamette Valley grass seed straw should be chopped shorter than 5 cm in order to be used as litter material for broiler production. Machine-slicing or flail-mower chopping of grass straws are not suitable methods to reduce the length of the straw as bedding material

for broiler production. Chopped annual rye grass straw and pelleted rye grass straw are more suitable litter sources than the chopped fine fescue, perennial rye grass, fescue, or orchard grass straws. Oregon broiler growers will use chopped rye grass straw for litter in their production units if a suitable and inexpensive machine to chop the straw can be identified. Presently, chopped straw has a significant economical advantage over wood shavings or sawdust.



Table 1. Seven-week performance data of commercial broilers reared on wood shavings, chopped annual rye, rye, orchard grass, fescue, and pelleted rye grass straw litter (Exp. 1)

Litter Material	Mean Body Weights			Feed Conversion	Mortality
	Males (M)	Females (F)	M + F		
	-----g-----				(%)
Wood shavings	2477 <sup>a</sup>	2068 <sup>ab</sup>	2263 <sup>a</sup>	2.14 <sup>a</sup>	2.5 <sup>a</sup>
Chopped annual rye grass straw (~5.1 cm long)	2572 <sup>a</sup>	2023 <sup>a</sup>	2277 <sup>a</sup>	2.15 <sup>a</sup>	1.7 <sup>a</sup>
Chopped perennial rye grass straw (~5.1 cm long)	2499 <sup>a</sup>	2118 <sup>ab</sup>	2313 <sup>ab</sup>	2.13 <sup>a</sup>	1.1 <sup>a</sup>
Chopped fescue straw (~5.1 cm long)	2522 <sup>a</sup>	2037 <sup>a</sup>	2286 <sup>ab</sup>	2.13 <sup>a</sup>	1.1 <sup>a</sup>
Chopped orchard grass straw (~5.1 cm long)	2499 <sup>a</sup>	2037 <sup>a</sup>	2286 <sup>ab</sup>	2.12 <sup>a</sup>	2.2 <sup>a</sup>
Pelleted rye grass straw (.32 cm dia)	2585 <sup>a</sup>	2136 <sup>b</sup>	2354 <sup>b</sup>	2.15 <sup>a</sup>	2.2 <sup>a</sup>
Pooled SEM	36	28	25	.01	.7

Mean values in each column with different superscripts are significant at  $P < .05$  except for combined male and female body weights which were significant at  $P < .1$ .

Table 2. Litter caking score of commercial broilers reared on wood shavings, chopped annual rye, chopped rye, chopped orchard grass, chopped fescue, and pelleted rye grass straw as litter (Exp. 1)

Litter Material	Mean Litter Caking Scores <sup>1</sup>						
	Weeks on Test						
	1	2	3	4	5	6	7
Wood shavings (control)	.1 <sup>a</sup>	.5 <sup>a</sup>	1.0 <sup>a</sup>	1.9 <sup>a</sup>	2.4 <sup>a</sup>	2.2 <sup>a</sup>	3.0 <sup>a</sup>
Chopped annual rye grass straw	.2 <sup>a</sup>	.9 <sup>ab</sup>	1.2 <sup>ab</sup>	1.8 <sup>a</sup>	2.5 <sup>a</sup>	2.2 <sup>a</sup>	3.0 <sup>a</sup>
Chopped perennial rye grass straw	.4 <sup>a</sup>	1.0 <sup>b</sup>	1.8 <sup>b</sup>	2.4 <sup>c</sup>	2.9 <sup>b</sup>	2.7 <sup>c</sup>	3.4 <sup>a</sup>
Chopped fescue straw	.4 <sup>a</sup>	1.2 <sup>b</sup>	1.6 <sup>b</sup>	2.2 <sup>bc</sup>	2.6 <sup>ab</sup>	2.3 <sup>ab</sup>	3.1 <sup>a</sup>
Chopped orchard grass straw	.4 <sup>a</sup>	1.1 <sup>b</sup>	1.8 <sup>b</sup>	2.1 <sup>abc</sup>	2.7 <sup>ab</sup>	2.5 <sup>abc</sup>	3.0 <sup>a</sup>
Pelleted rye grass straw	.1 <sup>a</sup>	.5 <sup>a</sup>	1.2 <sup>ab</sup>	1.9 <sup>ab</sup>	2.5 <sup>a</sup>	2.6 <sup>bc</sup>	3.2 <sup>a</sup>
Pooled SEM	.1	.1	.2	.1	.1	.2	.1

Mean values in each column with different superscripts are significantly different at  $P < .05$ .

<sup>1</sup>Litter scores:

- 1 = 1/4 of pen litter caked
- 2 = 1/2 of pen litter caked
- 3 = 3/4 of pen litter caked
- 4 = litter fully caked
- 0 = no caked litter

Table 3. Seven-week performance data with broilers reared on chopped rye grass seed straw with varied stocking densities (Exp. 2)

Litter Material	Stocking Densities	Mean Body Weight			Feed Conversion	Mortality
		Males (M)	Females (F)	M + F		
	m <sup>2</sup> /broiler	g				(%)
Wood shavings	.074	2791 <sup>a</sup>	2232 <sup>c</sup>	2282 <sup>a</sup>	2.07 <sup>b</sup>	4.3 <sup>a</sup>
Chopped annual rye grass straw (CRGS)	.074	2810 <sup>a</sup>	2150 <sup>b</sup>	2232 <sup>a</sup>	2.06 <sup>b</sup>	3.5 <sup>a</sup>
CRGS	.061	2599 <sup>a</sup>	2186 <sup>bc</sup>	2232 <sup>a</sup>	2.02 <sup>a</sup>	6.8 <sup>a</sup>
CRGS	.044	2594 <sup>a</sup>	2073 <sup>a</sup>	2164 <sup>a</sup>	2.02 <sup>a</sup>	4.5 <sup>a</sup>
Pooled SEM		67	23	28	.01	2.4

Mean values in each column with different superscripts are significantly different at  $P < .05$ .

Table 4. Weekly litter caking scores of broilers reared on chopped rye grass straw with varied broiler stocking densities (Exp. 2)

Litter Type	Stocking Densities (m <sup>2</sup> /bird)	Mean Litter Caking Scores <sup>1</sup>					
		Weeks of Age					
		2	3	4	5	6	7
Wood shavings	.074	.9 <sup>ab</sup>	.8 <sup>a</sup>	.9 <sup>a</sup>	2.0 <sup>a</sup>	2.2 <sup>a</sup>	1.8 <sup>a</sup>
Chopped annual rye grass straw (CRGS)	.074	.8 <sup>a</sup>	1.1 <sup>ab</sup>	1.4 <sup>ab</sup>	2.3 <sup>a</sup>	2.4 <sup>a</sup>	2.4 <sup>b</sup>
CRGS	.061	1.0 <sup>bc</sup>	1.3 <sup>b</sup>	1.5 <sup>b</sup>	2.4 <sup>a</sup>	2.9 <sup>b</sup>	2.8 <sup>bc</sup>
CRGS	.044	1.2 <sup>a</sup>	1.6 <sup>c</sup>	1.9 <sup>b</sup>	2.8 <sup>b</sup>	3.2 <sup>b</sup>	3.0 <sup>c</sup>
Pooled SEM		.1	.1	.2	.1	.1	.2

Mean values in each column with different superscripts are significantly different at P < .05.

<sup>1</sup>Litter Scores:

- 1 = 1/4 of pen litter caked
- 2 = 1/2 of pen litter caked
- 3 = 3/4 of pen litter caked
- 4 = litter fully caked
- 0 = no caked litter



Table 5. Observations of leg disorders of broilers reared on chopped rye grass straw with varied broiler stocking densities (Exp. 2)

Litter Type	Stocking Densities (m <sup>2</sup> /bird)	Foot Pad Dermatitis Incidence (Derm./total)	Other Leg Disorders
Wood shavings	.074	113/142 (79.6%)	2 crooked legs; 1 crooked toe
Chopped annual rye grass straw (CRGS)	.074	93/146 (63.7%)	2 crooked legs; 3 crooked toes; 1 small thigh
CRGS	.061	138/172 (80.2%)	4 crooked legs; 4 crooked toes
CRGS	.044	179/221 (81.0%)	1 crooked leg; 1 crooked toe; 1 malformed thigh

Table 6. Six-week broiler performance data for broilers reared on wood shavings, sliced fine fescue straw, sliced perennial rye grass straw, and flail-mower chopped perennial rye grass straw litter (Exp. 3)

Litter Materials	Mean Body Weight			Feed Conversion	Mortality
	Males (M)	Females (F)	M + F		
	-----g-----				(%)
Wood shavings	2114 <sup>a</sup>	1719 <sup>a</sup>	1910 <sup>a</sup>	1.91 <sup>a</sup>	1.3 <sup>a</sup>
Sliced fine fescue straw	2077 <sup>a</sup>	1737 <sup>a</sup>	1919 <sup>a</sup>	1.94 <sup>a</sup>	1.0 <sup>a</sup>
Sliced perennial rye grass straw	2077 <sup>a</sup>	1769 <sup>a</sup>	1923 <sup>a</sup>	1.92 <sup>a</sup>	3.5 <sup>a</sup>
Flail mower chopped perennial rye grass straw	2055 <sup>a</sup>	1701 <sup>a</sup>	1869 <sup>a</sup>	1.95 <sup>a</sup>	1.8 <sup>a</sup>
Pooled SEM	20	17	17	.01	.8

Mean values in each column with different superscripts are significant at  $P < .05$ .

Table 7. Weekly litter caking score for broilers reared on wood shavings, sliced fine fescue straw, sliced perennial rye grass straw, and flail-mower chopped perennial rye grass straw, and flail-mower chopped rye grass straw litter (Exp. 3)

Litter Materials	Mean Litter Caking Scores <sup>1</sup>				
	Weeks on Test				
	2	3	4	5	6
Wood shavings	.3 <sup>a</sup>	1.2 <sup>a</sup>	2.5 <sup>a</sup>	3.2 <sup>a</sup>	3.8 <sup>a</sup>
Sliced fine fescue straw	.7 <sup>b</sup>	1.4 <sup>a</sup>	3.1 <sup>b</sup>	3.8 <sup>b</sup>	3.9 <sup>a</sup>
Sliced perennial rye grass straw	.4 <sup>a</sup>	1.3 <sup>a</sup>	2.4 <sup>a</sup>	3.1 <sup>a</sup>	3.6 <sup>a</sup>
Flail mower chopped perennial	.7 <sup>b</sup>	1.3 <sup>a</sup>	3.0 <sup>b</sup>	3.8 <sup>b</sup>	3.8 <sup>a</sup>
Pooled SEM	.04	.1	.1	.1	.1

Mean values in each column with different superscripts are significant ( $P < .05$ ).

<sup>1</sup>Litter Scores:

- 1 = 1/4 of pen litter caked
- 2 = 1/2 of pen litter caked
- 3 = 3/4 of pen litter caked
- 4 = litter fully caked
- 0 = no caked litter

Table 8. Six-week performance data of broilers reared on wood shavings and chopped annual rye grass straw litter in 4.88 x 4.88 m floor pens (Exp. 4)

Litter materials	Mean body wts. (g)	Feed conversion	Mortality
Wood shavings	1952 <sup>a</sup>	2.02 <sup>a</sup>	3.6 <sup>a</sup>
Chopped annual rye grass straw	1977 <sup>a</sup>	2.01 <sup>a</sup>	3.9 <sup>a</sup>
SEM	29	.03	.5

Mean values in each column with same superscripts are not different ( $P > .05$ ).



Table 9. Weekly mean litter caking scores of broilers reared on wood shavings and chopped annual rye grass straw litter in 4.88 x 4.88 m floor pens (Exp. 4)

Litter Materials	Mean Litter Caking Scores <sup>1</sup>					
	Weeks on Test					
	1	2	3	4	5	6
Wood shavings	0	.6 <sup>a</sup>	.9 <sup>a</sup>	1.6 <sup>a</sup>	2.5 <sup>a</sup>	3.4 <sup>a</sup>
Chopped annual rye grass straw	0	.5 <sup>a</sup>	.9 <sup>a</sup>	1.6 <sup>a</sup>	2.5 <sup>a</sup>	3.3 <sup>a</sup>
SEM		.03	.05	.03	.04	.03

Mean values in each column with same superscripts were not different (P > .05).

<sup>1</sup>Litter Scores:

- 1 = 1/4 of pen litter caked
- 2 = 1/2 of pen litter caked
- 3 = 3/4 of pen litter caked
- 4 = litter fully caked
- 0 = no caked litter

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