WATER-HOLDING CAPACITIES OF BEDDING MATERIALS FOR LIVE STOCK, AMOUNTS REQUIRED TO BED ANIMALS, AND AMOUNTS OF MANURE SAVED BY THEIR USE

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For 25 years investigators and teachers have been expressing erroneous conclusions as to the relative values of shavings, sawdust, and the straws for bedding live stock. These conclusions are based upon a table showing the relative liquid-absorbing capacities of various substances which appeared in 1893 (*5*).[1] This table, which follows, was adapted from Deherain (*4*).

Absorption of liquids by litter

Kind of litter.	Water retained by 100 kgm. of material after 24 hours.	Quantity of material necessary to replace 100 kgm. of wheat straw.
	Kgm.	*Kgm.*
Wheat straw	220	100
Barley straw	285	77
Oat straw	228	96
Partially decomposed oak leaves	162	136
Peat	500–700	40
Sawdust of poplar wood	435	50
Spent tan bark	400–500	48
Air-dried vegetable mold	50	440

According to this table sawdust has almost twice the water-holding capacity of wheat or oat straw. Not only has this point been repeatedly referred to, but the conclusions have also been drawn that sawdust or shavings will go nearly twice as far as straw as bedding for live stock and will save a much larger portion of the liquid manure.

The above table, or portions of it, have been copied in a number of publications (*2*, *3*, *7*).

On the basis of these figures, the statement is made in Vermont Bulletin 206 that—

> Nine pounds of straw or six pounds of shavings are needed to absorb a cow's 24 hour voidings.

Special Circular 11 of the Dominion of Canada Experimental Farms (*1*) states concerning "dry sawdust and fine shavings" that—

> Their absorptive capacity according to fineness and dryness is from two to four times that of ordinary straw.

[1] Reference is made by number (italic) to "Literature cited," p. 190.

The values given in this old French table are reversed by tests on the absorptive capacity of oat straw, wheat straw, and shavings, conducted by the writer in the spring of 1917. These tests show that oat straw absorbs 15 to 20 per cent more water than wheat straw and more than twice as much as ordinary commercial mixed shavings. The tests are well substantiated by records kept of the amount of bedding material of the different kinds actually used for different classes of animals.

In order to determine the water-holding capacity of the various materials, weighed quantities (5 to 7 pounds per sack) were sacked loosely and soaked for 12 hours. The sacks were then hung in a room in a barn, and after 5 hours, when dripping had practically ceased, were weighed. They were weighed again after hanging for 24 hours. This test was repeated several times. There was a small variation from time to time, probably due to differences in the particular samples of material obtained and to differences in the rate of evaporation on different days. However, they were relatively the same in each test. In addition to oat straw, wheat straw, and two kinds of shavings which were being used for bedding purposes, some cut oat straw, some mixed sawdust, and some very light, fine white-pine shavings were obtained for these tests. Approximate averages of the results of the tests are given in Table I.

TABLE I.—*Water-holding capacity of litter*

Material.	Water retained by 100 pounds of material after 24 hours.	Relative water-holding power after 24 hours.
	Pounds.	
Oat straw (whole)	250	100.0
Cut oat straw (about ½-inch lengths)	244	97.6
Wheat straw	210	84.0
Mixed shavings from Chicago car load	119	47.6
Mixed shavings from local planing mill	130	52.0
Mixed sawdust from local planing mill	160	64.0
Fine, dry white-pine shavings	185	74.0

It will be noted that whole oat straw retained slightly more water than cut oat straw, about 19 per cent more than wheat straw, and twice as much as the ordinary mixed shavings used for bedding material. Whole oat straw came out slightly above the cut oat straw in every test made.

The fine white-pine shavings and the sawdust retained considerably more water than the coarser mixed shavings, the white-pine shavings retaining three-fourths as much water as oat straw, and the sawdust two-thirds as much. It was impossible to get any accurate comparison between shavings and sawdust of the same kind, because the only kind of sawdust obtainable was mixed. The water-holding capacity of the sawdust varied more than that of any of the other materials.

At the same time that these tests were being made, records were being kept on the relative amounts of oat straw, wheat straw, and shavings required to keep beef cows, dairy cows, and horses bedded, and on the amounts of manure saved by the use of each kind of bedding.

Twelve head of beef cows kept in single stalls were divided into three comparable lots. One lot was bedded with oat straw, one with wheat straw, and one with shavings from a car load bought in Chicago. The wheat-straw and shavings lots were reversed at the middle of the 60-day period. With the dairy cows only two lots were used, 9 head in one lot and 10 head in the other. One lot was bedded with oat straw and the other with shavings from the local planing mill. The lots were reversed at the middle of the 30-day period. Only 3 horses were used: draft mares in box stalls, one bedded with each kind of material. The shavings used were from Chicago.

The animals were all handled in the usual way. The beef cows were out of the barn about 9 hours a day, the dairy cows about 8½ hours, and the horses about 9. No special attempt was made to regulate the amount of bedding used, the men in charge of each barn bedding as usual. The barns were cleaned out daily—that is, the manure and soiled part of the litter were removed. Table II shows the amount of bedding used.

TABLE II.—*Material used in keeping animals bedded*

Animals, period, and material.	Total bedding used.	Amount per animal per day.	Relative amount used.
Horses (1 per lot, 49 days):	*Pounds.*	*Pounds.*	
Oat straw	716	14.61	100
Wheat straw	844	17.22	118
Shavings	1,192	24.32	166
Beef cows (4 per lot, 60 days):			
Oat straw	1,766	7.36	100
Wheat straw	1,928	8.03	109
Shavings	3,207	13.36	182
Dairy cows (9½ per lot, 30 days):			
Oat straw	2,064	7.24	100
Shavings	2,892	10.15	140

In keeping the animals bedded, 40 to 82 per cent more shavings than oat straw and 9 to 18 per cent more wheat straw than oat straw were used. About 15 pounds of oat straw per day was required to keep one of the horses bedded, about 7⅓ pounds to keep one of the cows bedded. The horses were on an earth floor, the cattle on concrete floors. The Ohio Station found that about 7 pounds of straw were needed for steers on concrete floors (*6*).

From the fact that the oat straw was capable of absorbing more liquid than wheat straw or shavings, one might suppose that more of the manure from the animals could be saved by the use of oat straw. In this experiment, however, about the same amount of animal excreta was saved, regardless of the kind of bedding used. To be sure, less oat

straw was used as bedding to save the same amount of excreta. Table III shows the material removed.

TABLE III.—*Amount of manure saved by use of the various litters*

Animals and material.	Total manure removed.	Bedding used.	Excreta removed.	Excreta removed per animal per day.
Horses:	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Oat straw	3,551	716	2,835	57.8
Wheat straw	3,409	844	2,565	52.3
Shavings	3,925	1,192	2,733	55.7
Beef cows:				
Oat straw	10,227	1,766	8,461	35.2
Wheat straw	10,820	1,928	8,892	37.0
Shavings	12,190	3,207	8,983	37.4
Dairy cows:				
Oat straw	17,831	2,064	15,767	55.3
Shavings	18,214	2,892	15,322	53.7

While there is a variation of several per cent in the amount of excreta saved with each class of animals with the different kinds of bedding, still the variations are not large and are not consistently in favor of any one kind of material. It is evident that there is no very important difference in the amount of excreta saved as a result of the use of one or another of these materials.

SUMMARY

(1) The common belief that the shavings commonly used for bedding live stock have much greater water-holding capacity than straw is erroneous. Oat straw retained approximately twice as much water as shavings and 15 to 20 per cent more than wheat straw.

(2) To keep animals bedded, 40 to 82 per cent more shavings than oat straw and 9 to 18 per cent more wheat straw than oat straw were required.

(3) The amount of animal excreta removed from the barn in the manure was about the same regardless of the kind of bedding material used.

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