

Value and Use of Tobacco Stalks in Farm Practice

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CONTENTS

	Page
AMOUNT AND VALUE OF TOBACCO STALKS PRODUCED IN KENTUCKY	3
LOSS OF NUTRIENTS FROM TOBACCO STALKS	5
NUTRIENTS LEACHED FROM STALKS SPREAD ON LAND DURING WINTER	7
USE OF WHOLE AND CUT TOBACCO STALKS FOR BEDDING FOR LIVESTOCK	8
CARRYOVER OF TOBACCO MOSAIC IN TOBACCO STALKS APPLIED TO LAND	10
COMPOSTING EXPERIMENTS	11
RECOMMENDATIONS FOR HANDLING TOBACCO STALKS	11
Piling	11
Spreading Directly on the Land	11
Stalks for Bedding	12

Value and Use of Tobacco Stalks in Farm Practice

By MARTIN E. WEEKS and P. E. KARRAKER

TOBACCO STALKS are an important byproduct on Kentucky farms. Their main value at present¹ lies in the great amount of fertilizer nutrients, especially nitrogen and potassium, they contain. In ordinary farm practice in Kentucky, the full fertilizer value from the stalks often is not obtained because of considerable losses of nutrients incurred in handling or storing them. The whole stalks, bulky and woody as they are, are difficult to spread on the land, and when so spread may interfere with the operation of certain farm machines. Grinding or cutting the stalks adds expense and requires heavy machinery not available on many farms. For these reasons, too many tobacco stalks throughout the state are piled outside the barn to weather and rot away, or are spread on an idle field where their value is not fully utilized.

For these reasons, a study was made at this Station of methods of handling tobacco stalks, and especially of the loss of plant nutrients that occurs when the stalks are exposed to the weather.

Amount and Value of Tobacco Stalks Produced in Kentucky

A fairly accurate estimate of the amount of tobacco stalks produced in Kentucky can be made from the ratio of the weight of cured leaf to the weight of stalk. This ratio varies considerably, depending on growth conditions and yield of leaf.² However, the average ratio is fairly constant for any given type and yield of tobacco. This average ratio from two experiment fields was 1.5 to 1 for burley and 3.3 to 1 for the heavy-leaved dark-fired and air-cured tobaccos.

From these ratios and the yields of leaf of the different types of tobacco as given by the U. S. Dept. Agr. Bur. of Agr. Econ. Crop Report for July, 1945, the tonnage of tobacco stalks produced in Ken-

¹ Industrial uses of tobacco stalks have been explored at this Station (See Ky. Agr. Exp. Sta. Bul. 439, 1942) but no extensive outlet of this kind has developed thus far.

² Ky. Agr. Exp. Sta. Bul. 453, 1943, pp. 24-25; and unpublished data from Kentucky soil experiment fields.

Table 1.—Amount of tobacco leaf and estimated amount of stalks produced in Kentucky in 1942-44

Tobacco type	1942		1943		1944		Ratio, leaf to stalk
	Leaf	Stalks	Leaf	Stalks	Leaf	Stalks	
	tons	tons	tons	tons	tons	tons	
Fire cured							
Hopkinsville and Clarksville (22)	6,815	2,065	6,850	2,015	4,500	1,363	3.3:1
Paducah and Mayfield (23)	8,895	2,695	7,200	2,162	6,500	1,970	3.3:1
Henderson (24)	90	27	45	14	48	16	3.3:1
Burley (31)	120,480	80,320	134,663	89,775	209,150	139,436	1.5:1
Dark air-cured							
One sucker (35)	6,955	2,107	6,695	2,029	10,063	3,049	3.3:1
Green River (36)	7,468	2,263	5,463	16,550	8,250	2,500	3.3:1
Total	150,703	89,477	160,716	97,670	238,511	148,333	

Table 2.—Average and range in nutrient content of 75 samples of air-dry tobacco stalks

Nutrient	Range, percent	Average, percent	Pounds per ton
Nitrogen	1.77 to 3.55	2.73	56
Phosphorus28 to .42	.33	7
Potassium	1.35 to 4.85	2.51	50

tucky during 1942, 1943, and 1944 was calculated (Table 1). Kentucky farmers had about 89,000 tons of tobacco stalks in 1942, nearly 98,000 tons in 1943, and about 148,000 tons in 1944. The approximate value of these stalks in dollars per year can be calculated from average analyses of major plant food nutrients in the stalks and the cost of such nutrients in commercial fertilizer.¹ Though nutrient content of tobacco stalks varies greatly, averages of many samples from all parts of the state should provide a sufficiently accurate basis for the calculation of approximate value of the fertilizer nutrients in tobacco stalks produced in the state. Table 2 shows the average and range in percentage of nitrogen, phosphorus, and potassium in 75 tobacco stalk samples representing crops over several years from central Kentucky and some of the outlying soil experiment fields. The stalks averaged 55 pounds nitrogen, 7 pounds phosphorus, and 50 pounds of potassium per ton.

Assuming that these data are representative of Kentucky tobacco generally, the nutrient content and value of the stalks produced in Kentucky in 1942, 1943, and 1944 would be as given in Table 3. On

¹ Disregarding any possible value of organic matter or minor nutrients contained in the stalks.

Table 3.—Estimated nutrient content and value of tobacco stalks produced in Kentucky, 1942-44

	Stalk production	Nitrogen	Phosphorus	Potassium	Estimated value*
	tons	lb.	lb.	lb.	
1942	89,500	4,885,000	590,000	4,491,000	\$ 892,000
1943	97,700	5,233,000	644,000	4,903,000	974,000
1944	148,300	6,099,000	978,000	7,446,000	1,480,000

* Nitrogen valued at 10 cents, phosphorus at 13.1 cents, and potassium at 7.2 cents per pound.

the average during these three years, the tobacco stalks produced in Kentucky contained about 6 million pounds of nitrogen, 740,000 pounds of phosphorus, and 5½ million pounds of potassium, with a plant-food value somewhat over 1 million dollars. This amounts to about one-third of the total nutrient content of the tobacco crop. For each 1,000 pounds of burley tobacco sold, a farmer has, on the average, about 666 pounds of stalks worth \$3.50; and for each 1,000 pounds of dark fire-cured or air-cured tobacco, about 300 pounds of stalks worth \$1.50.

Loss of Nutrients from Tobacco Stalks

The greater part of the nitrogen, phosphorus, and potassium in fresh stalks is soluble in water and is easily lost if the stalks are exposed to rain. To determine the exact amount of water-soluble nutrients in several lots of tobacco stalks, the stalks were ground, 2½ gram portions of the powder were shaken in 250 ml of water, the mixture was filtered, and the filtrate was analyzed for nitrogen, phosphorus, and potassium (Table 4). An average of 73 percent of the value of the plant nutrients in the stalks was found to be readily soluble in water.

It is common practice in Kentucky to spread whole tobacco stalks on lawns and pastures or meadows in winter to improve the growth of grass through the leaching out of plant food nutrients from the stalks by winter rains. If the stalks are not left on too long in the spring, this method of improving the growth of lawn grasses is quite effective. In an experiment to determine the rate of loss of nutrients from whole tobacco stalks spread out in this manner, three lots of stalks were spread on a lawn in the middle of January. At the same time another lot of stalks was piled under the eaves of a shed in the manner followed on many farms where the stalks are thrown into a pile outside the barn. One of these lots was picked up in 50 days, one in 79 days, and another in 109 days, dried out, weighed, ground, and analyzed to determine losses in dry matter, nitrogen, phosphorus, and potassium.

Table 4.— Percentage of the nitrogen, phosphorus, and potassium content of tobacco stalks that is soluble in water

Sample	Nitrogen	Phosphorus	Potassium
1	43	84	100
2	56	87	99
3	67	87	100
4	52	87	97
5	54	80	97
Average	54	81	99

Very great losses of plant nutrients occurred (Table 5 and Fig. 1). Practically all the water-soluble nutrients (Table 4) were lost in 109 days from the whole stalks spread on the lawn. This is shown by comparing the data for percentage of nitrogen, phosphorus, and potassium lost in 50, 79, 109, and 112 days (Table 5) with the percentage of total water-soluble nutrients in the same lot of tobacco—sample 3 in Table 4. Losses from whole stalks in the pile under the eaves were less than from those spread on the lawn, yet most of the soluble nitrogen and potassium of the piled stalks was lost in 112 days. Losses from very large piles probably would be considerably less because much more of the rainwater would be shed or absorbed by the stalks.

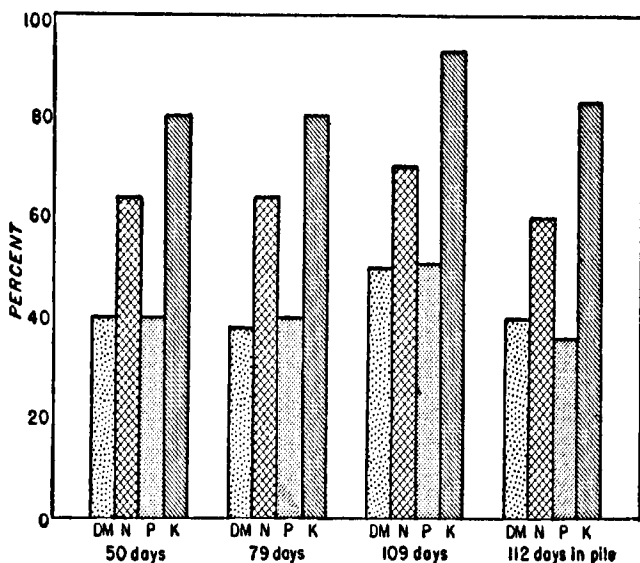


Fig. 1.— Percentage of original dry matter and nutrients lost from whole tobacco stalks exposed to winter rains for varying periods from January 12 to May 3, 1944

Table 5.—Effect of exposure to winter rain on weight and nitrogen, phosphorus, and potassium content of whole tobacco stalks

Item	Kept inside	Spread on lawn			Piled outside 112 days
		50 days	79 days	109 days	
Nitrogen, percent	2.73	1.71	1.59	1.63	1.00
Phosphorus ^a percent	0.31	0.24	0.30	0.30	.32
Potassium ^b percent	3.42	1.15	1.04	0.37	0.98
Percent of the nitrogen content lost		62	63	69	61
Percent of the phosphorus content		52	39	50	38
Percent of the potassium content		80	80	94	83
Percent of dry matter lost		40	37	48	41
Initial weight of sample, pounds		30	19	29	47
Final weight of sample, pounds		12	12	15	27.7
Rainfall during exposure, inches		3.57	9.16	13.37	13.37

^a To get "phosphoric acid" content, as stated in fertilizer analyses, multiply by 2.39. Thus, the stalks contained originally 0.71 percent "phosphoric acid" (0.31×2.29).

^b To get "potash" content, as stated in fertilizer analyses, multiply by 1.3. Thus the stalks contained originally 4-10 percent of "potash." (3.42×1.3) So these stalks are a 2.7-0.7-4.0. fertilizer.

Nutrients Leached from Stalks Spread on Land During Winter

Plant nutrients leached out of tobacco stalks spread on the soil during the winter are, to a greater or less extent, taken up and held by the soil minerals or by the microorganisms and cover crops that grow in the soil. Ammonia nitrogen is absorbed by the soil, and this and other soluble forms of nitrogen are taken up by bacteria and crops. Potassium and especially phosphorus are largely absorbed by the soil, though some of both are taken up by organisms and plants.

Some loss of nitrogen and potassium by leaching through the soil or by erosion is to be expected from stalks spread on the land in winter. The amount of such loss of nitrogen depends on the kind and condition of the cover crop, on temperature, and the amount of precipitation. The loss of potassium varies with precipitation, but is affected much less by the cover crop than the loss of nitrogen.

Effect of cover crop on loss of nitrogen and potassium by leaching is shown by data in Table 6, from lysimeters on the Station farm. Greatest loss of both nutrients occurred during January, February, and March. Loss of nitrogen was nearly prevented by a good cover crop. Loss of potassium, on the other hand, appeared to be in no way related to nitrogen loss nor to the kind or condition of cover crop.

Table 6.—Average amounts of nitrogen and potassium lost in drainage from lysimeters at Lexington during six winter and spring months, 1939 and 1940
(Pounds lost per acre)

Crop cover	January - March		April - June	
	Nitrogen	Potassium	Nitrogen	Potassium
Lespedeza _____	43	39	10	28
White clover _____	47	44	6	21
Red clover _____	33	43	3	14
Alfalfa _____	15	40	1	8
Bluegrass _____	4	39	1	19
Lespedeza and rye _____	18	58	1	19
Bluegrass and lespedeza _____	8	39	2	25
Bluegrass and white clover _____	3	44	1	19
Bluegrass and red clover _____	3	46	2	25
Bluegrass and alfalfa _____	1	61	2	23
Fallow _____	51	38	10	26

Use of Whole and Cut Tobacco Stalks for Bedding for Livestock

Some farmers use whole or ground or cut tobacco stalks for bedding under livestock. Many of these men have found that the stalks break up quite readily under the hoofs of horses and cattle and that such stalks can be handled easily in manure spreaders, are easily plowed under, and do not interfere with subsequent field operations in the way that whole dry stalks frequently do.

During the winter of 1944 and 1945 several experiments were made by this Station testing whole and cut tobacco as bedding for horses and for steers. The stalks were compared with wheat straw in relative effectiveness in keeping the animals clean, and the resulting manure was analyzed to see whether the large amounts of nitrogen and potassium in the stalks were held in the manure.

In the experiments with stalks under horses, it was found that the whole stalks broke up very readily under the animals' hoofs. They were found to be quite effective in absorbing liquid, and the manure was richer in nutrients than the original stalks. The stalks contained 1.77 percent nitrogen, 0.39 percent phosphorus, and 2.73 percent potassium; and the manure contained 1.83 percent, 0.49 percent, and 3.06 percent respectively of these elements.

The second experiment was begun February 1, 1944, in the beef-cattle barn, to compare whole stalks, stalks cut in 1-inch pieces with an ensilage cutter, and wheat straw, for bedding under beef steers. Two yearling steers were kept in each of three stalls at night and allowed to run on pasture during the day. One stall was bedded with

wheat straw and the other two were bedded respectively with whole stalks and cut stalks. Bedding materials were added as needed to keep the animals clean. This experiment ran until February 28. All bedding materials were weighed and the moisture content determined.

At the end of the experiment, the manure from each stall was removed, mixed, and weighed, and a sample was taken for moisture determination and analysis. The data obtained are given in Table 7. When the amounts of nitrogen, phosphorus, and potassium added in the bedding was deducted from the amounts in the manure, the remainder (representing the nutrient content of the animal excrement) per equal weight of excrement, was nearly the same in all stalls. The range for nitrogen was 11.4 to 11.8 pounds; for phosphorus, 2.29 to 3.83 pounds; and for potassium, 7.1 to 8.4 pounds per ton of fresh manure. Considering the difficulties in sampling and analyzing materials of this kind, the differences were believed to be

Table 7.—Fertilizer nutrient content of cow manure, with straw and with tobacco-stalk bedding

	Kind of bedding used		
	Straw	Whole tobacco stalks	Cut tobacco stalks
Manure (including bedding) in each stall, pounds	1,095	1,225	1,020
Bedding per stall, pounds	192	238	539
Manure minus bedding, pounds	903	986	1,041
Percent of nutrients in manure			
Nitrogen	0.63	0.83	1.07
Phosphorus	0.58	0.49	0.54
Potassium	1.45	3.20	3.93
Pounds of nutrients in manure			
Nitrogen	6.90	10.30	17.30
Phosphorus	1.90	1.65	3.05
Potassium	4.78	11.25	22.12
Percent of nutrients in bedding			
Nitrogen	0.92	2.40	3.00
Phosphorus	0.19	0.27	0.30
Potassium	0.58	4.00	4.50
Pounds of nutrients in bedding			
Nitrogen	1.50	4.90	11.90
Phosphorus	0.17	0.52	1.23
Potassium	0.94	7.56	18.20
Nutrients in manure minus nutrients in bedding, pounds—			
Nitrogen	5.40	5.00	6.39
Phosphorus	1.73	1.13	1.81
Potassium	3.83	3.62	3.62
Nutrients in 1 ton of manure minus nutrients in 1 ton of bedding, pounds—			
Nitrogen	11.00	11.00	11.50
Phosphorus	3.83	3.29	3.27
Potassium	8.60	7.50	7.10

well within the limit of experimental error. There was thus evidently no important loss of nutrients from the bedding materials or the excrement.

In keeping cattle clean and preventing loss of nutrients from the manure, both whole and cut tobacco stalks proved to be quite satisfactory as bedding. The whole stalks would probably serve somewhat better if a little straw were used along with them in the stalls. The most convenient and effective way to use tobacco stalks for bedding would be to have them cut into pieces 2 to 6 inches in length. This could be done by running them through a corn shredder or ensilage cutter with part of the knives removed.

Carryover of Tobacco Mosaic in Tobacco Stalks Applied to Land

Kentucky tobacco growers commonly apply much of the manure produced on the farm to land being prepared for tobacco. Many producers also spread tobacco stalks on these fields. However, if tobacco stalks carrying tobacco mosaic virus were applied directly to the land or were used for bedding and then spread with the manure, there would seem to be danger of the virus being carried over and infecting the new crop. Experiments were therefore made, in cooperation with the plant pathology section of this Station, to determine how long the mosaic virus would remain active in whole tobacco stalks spread on the land or mixed with manure.

To provide a supply of diseased stalks for these experiments, a number of tobacco plants in the 1944 crop were inoculated with mosaic virus in the field. In March, 1945, the following experiments were begun: (1) twenty-five of the diseased stalks were spread out on the lawn; (2) a layer of the stalks was placed between two layers of cow manure and protected so the stalks would not dry too rapidly; (3) a layer of stalks was similarly placed between two layers of horse manure. Samples of stalks were taken from these lots from time to time over a period of 68 days, by cutting off the tips of a number of the stalks in each treatment. These samples were then dried and tested for active virus. At the beginning of the period a sample of the original untreated stalks was tested to make certain the virus was present. The data from these experiments are given in Table 8. At the end of 15 days no active virus remained on the stalks between the layers of manure, and after 26 days no active virus remained in whole tobacco stalks spread on the lawn.

Table 8.—The effect of weathering and contact with manure on the activity of tobacco mosaic virus

(Figures denote number of lesions produced on growing tobacco of N-N mosaic resistant burley leaf by inoculum prepared from stalks at start and after exposure.)

	At start, Mar. 14	After 4 days	After 15 days	After 26 days	After 36 days	After 68 days
Stalks at start of experiment	33	—	—	—	—	—
Stalks spread on lawn	—	75	20	0	0	0
Stalks in cow manure	—	0	0	0	0	0
Stalks in horse manure	—	0	0	0	0	0

* No sample taken.

Composting Experiments

A number of experiments were tried in composting whole tobacco stalks. In some, tobacco stalks alone were used with hydrated lime and a little 6-8-6 fertilizer. In others stalks were composted with straw, horse manure, and soil, either with or without lime. It was found that good results could be obtained only if a considerable quantity of water was added to the compost and if considerable care was used in packing it down. In most cases the seasonal rainfall would not be sufficient for best results with composting, under Kentucky conditions.

Recommendations for Handling Tobacco Stalks

On the basis of this study, in which it was found that about 76 percent of the plant food nutrients in tobacco stalks is readily lost by leaching with water, the following recommendations on the handling of tobacco stalks so as to obtain from them their full fertilizer value, can be made:

Piling.—At stripping time, stalks should be piled and stored under cover till spring to prevent loss from weathering. If it is necessary to pile them outside, they should be piled or stacked in large piles to reduce leaching by rain. Putting straw or other crop residues in the outside piles with them is advisable when possible.

Spreading directly on the land.—Spreading tobacco stalks during the winter should be on fields where there is pasture, meadow, or small grain. If spreading on these crops is delayed until spring, less loss of nutrients is likely to occur. Loss of nutrients should also be small where the stalks are spread in the spring and plowed under on land to go into corn or tobacco. When spread or applied in any of these ways, however, whole stalks may interfere to some extent with necessary tillage or harvesting operations on the land before they rot.

This latter difficulty can be avoided if the stalks are put through an ensilage cutter, corn shredder, or hammermill; but the expense of handling the stalks is increased considerably thereby. Stalks spread on land to go into tobacco, should be spread during the winter and should be completely plowed under, unless one of the Kentucky mosaic resistant varieties is to be set. This procedure will avoid any possible trouble from mosaic virus diseases. Care must be taken not to spread the stalks too thick. For ordinary farm crops they should not be applied at a rate higher than one ton per acre.

Stalks for bedding.— Whole tobacco stalks make very satisfactory bedding material in loose stock sheds especially under cattle and horses. They are not satisfactory in stalls that are cleaned out frequently. If used, preferably with some straw, in sufficient quantity to keep the animals clean, there should be little loss of nutrients. On land being prepared for tobacco, the manure should be spread at least a month before the plants are set.

If used in dropping pits for poultry, the stalks should be cut or shredded and some superphosphate (about 100 to 200 pounds per ton) should be used to hold ammonia and retard bacterial decomposition in the manure.

HOW TO GRADE YOUR PLACINGS

**Table for Use in Determining Grades in Crops Judging Work
(Placing 4 Samples)**

Placing	Value	Placing	Value
1 2 3 4 or A B C D.....	100	2 1 3 4 or B A C D.....	85
1 2 4 3 or A B D C.....	95	2 1 4 3 or B A D C.....	80
1 4 2 3 or A D B C.....	75	2 3 1 4 or B C A D.....	65
1 4 3 2 or A D C B.....	60	2 3 4 1 or B C D A.....	35
1 3 2 4 or A C B D.....	90	2 4 1 3 or B D A C.....	45
1 3 4 2 or A C D B.....	70	2 4 3 1 or B D C A.....	15
Placing	Value	Placing	Value
3 1 2 4 or C A B D.....	60	4 1 2 3 or D A B C.....	30
3 1 4 2 or C A D B.....	55	4 1 3 2 or D A C B.....	25
3 2 1 4 or C B A D.....	40	4 2 1 3 or D B A C.....	20
3 2 4 1 or C B D A.....	12	4 2 3 1 or D B C A.....	5
3 4 1 2 or C D A B.....	10	4 3 1 2 or D C A B.....	3
3 4 2 1 or C D B A.....	7	4 3 2 1 or D C B A.....	0

In grading the results of a Crops judging contest, it is relatively simple when the samples can be numbered 1-2-3-4 or A-B-C-D and the official placings are in that order. It is then a matter of reading your placing directly from the score sheet. Thus, the placing, if it should be 3-1-2-4 or C-A-B-D, could be read directly off the score sheet and would receive 60 or a placing of 2-1-4-3 or B-A-D-C would receive 80.

Sometimes the official placing will not be 1-2-3-4 or A-B-C-D. Then an interpretation will have to be made. For instance, suppose the official placing should be 3-1-2-4 or C-A-B-D. The contestant places the samples 2-1-3-4 or B-A-C-D. Now the question is—what should be the contestant's score:

Example

- 3-1-2-4 or C-A-B-D—Official Placing
- 2-1-3-4 or B-A-C-D—Student Placing
- 3-2-1-4 or C-B-A-D—Interpretation

Look for the placing 3-2-1-4 or C-B-A-D in the Table. You will find it has a value of 40. On a four sample placing, if the official placing were 3-1-2-4 or C-A-B-D and the contestant's placing 2-1-3-4 or B-A-C-D, then, according to the official placing, ear No. 2 or B should be third, ear No. 1 or A should be second, ear No. 3 or C should be first, and ear No. 4 or D should be fourth; or the

contestant's placing in terms of the official placing is 3-2-1-4 or C-B-A-D and when read off the score sheet receives 40. After some practice it is quite easy to determine the grades.

In order to make the grading easy, especially for the beginning club leaders and members, we would suggest that the sample be marked using the four letters A-B-C-D. If you would like to have sheets giving all possible placings, using the letters A-B-C-D, write the 4-H Club Department. This makes grading placings a very easy job.

The quiz should be graded and this score added in with the scores on the placings. The total of these eight grades will be the contestant's grade out of a possible 800 points.

REMEMBER

"Judging is a Method of Teaching and a Way of Learning"

COOPERATIVE EXTENSION WORK IN AGRICULTURE AND
HOME ECONOMICS

State of Indiana, Purdue University
and the United States Department of Agriculture Cooperating
H. J. Reed, Director, Lafayette, Indiana

Issued in furtherance of the Acts of May 8 and June 30, 1914.