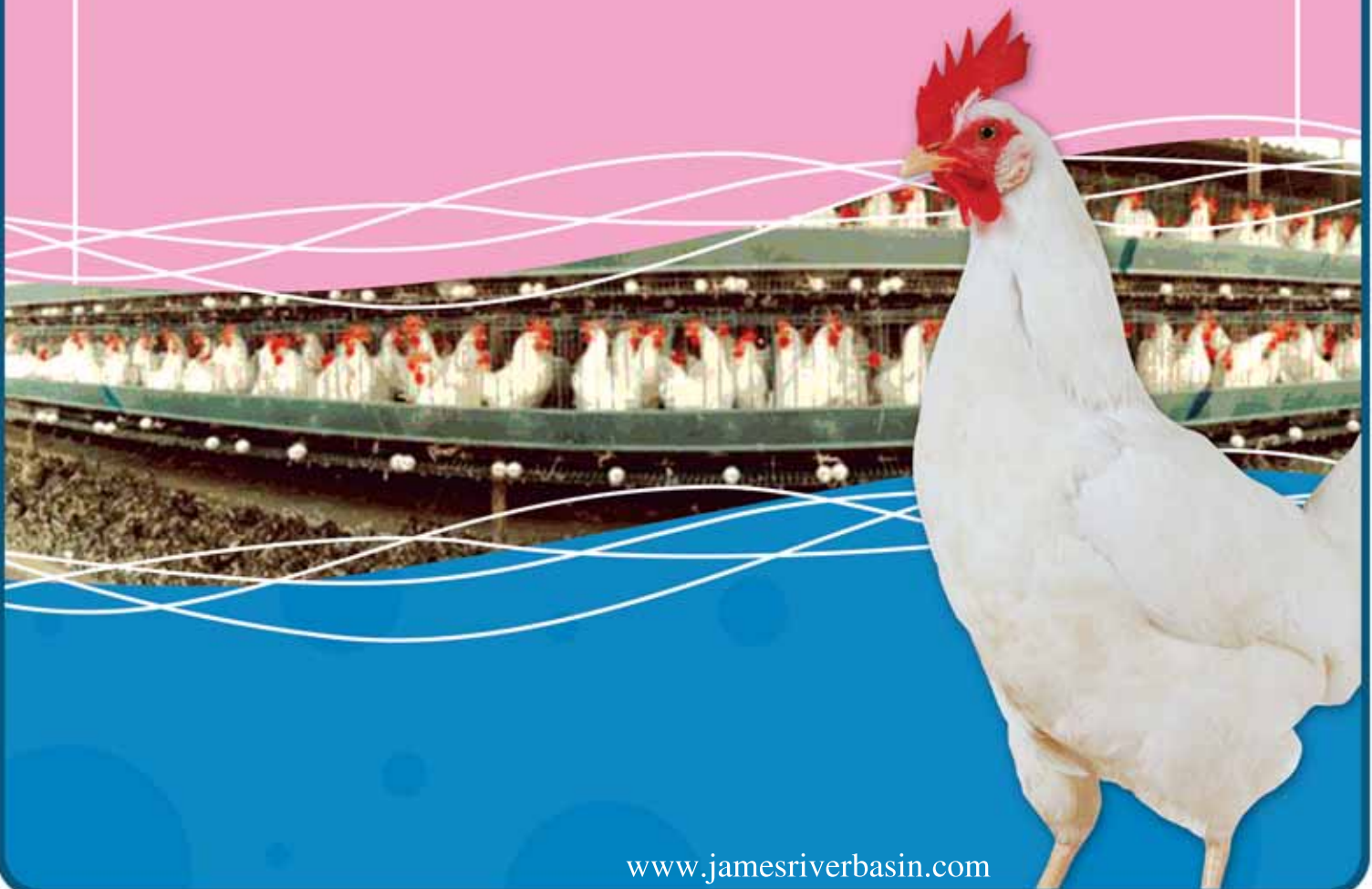




Use of Poultry Litter in Southwest Missouri

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INTRODUCTION

Application of poultry litter as fertilizer throughout Southwest Missouri is a growing practice. Poultry litter contains several nutrients required by crops and higher plants. Composed of bedding material and organic waste produced by poultry, litter contains phosphorus (P), nitrogen (N), and trace nutrients such as copper (Cu), sulphur (S), calcium (Ca), and boron (B) (Evers, 2002). The value of this material as fertilizer for agricultural lands lies in its N:P ratio. Most higher plants are limited in growth potential by the availability of nitrogen, and reach maximum growth potential at a N:P ratio of 6-10:1 (McLaughlin et al., 2004). Poultry litter, on average, has a N:P ratio of 2.2:1 (Evers, 2002). Plants reach their maximum uptake of nitrogen while much of the phosphorus is left behind. The phosphorus can then either be adsorbed by soil particles or dissolved in rainwater. This dissolved or particulate phosphorus is then washed into adjacent streams during rainfall events and potentially lead to reduced water quality. Excess phosphorus in waterways provides much-needed nutrients for algae and can result in blooms. The algae subsequently dies off, consumes dissolved oxygen contained in the water column, and provides an oxygen-poor environment that reduces the ability for fish to proliferate (Evers, 2002).

The poultry industry is a large industry in Southwest Missouri and produces a great deal of litter annually. The industry provides \$1.78 billion to the area economy annually, with an average of 20,000 birds housed in each facility at any given time (Carlisle, 2003; Robinson and Sharpley, 1995). Approximately 100 - 120 tons of litter are produced per annum by 100,000 chickens, providing a management challenge for many poultry producers (Carlisle, 2003). Storage and transportation of poultry litter can

be costly for producers; therefore, facilities apply much of the litter produced on-site directly to their own land (Robinson and Sharpley, 1995). This results in over-application of litter and an increase in phosphorus runoff. Alternative uses for poultry litter, such as usage as a fuel, are currently being examined state-wide (Carlisle, 2003).

The Southwest Missouri Poultry Survey was created to answer a number of questions regarding usage of poultry litter in southwest Missouri. First, we set out to determine the association between the frequency of poultry litter use and farmers' awareness of current educational literature from three agencies, in addition to farmers' awareness of different types of usage. We predicted that farmers who had a higher degree of awareness of poultry litter usage would be more likely to use poultry litter. Second, we wanted to determine the association between litter usage and implementation of a Nutrient Management Plan (NMP). We predicted those farmers who have used poultry litter as fertilizer would more frequently have NMPs than those that do not use poultry litter. We wanted to determine if farmers who use poultry litter have their soil tested regularly and what the characteristics of farms within each county were. Particularly, which counties had a higher proportion of farms applying poultry litter. Finally, we determined what barriers were important in preventing farmers from using poultry litter.

As a result, we hope to determine how poultry litter can be used more efficiently throughout southwest Missouri and use this information to develop a plan to help the poultry industry to dispose of litter and to reduce the negative effects of poultry litter on area water quality.

METHODS

Survey Development and Distribution

The survey was developed by a committee consisting of representatives from the poultry industry, agriculture, water quality groups, and Southwest Missouri State University (Appendix 1). The survey was pre-tested with a small group of farmers then revised.

Surveys were distributed a variety of ways including using mailing lists from the University of Missouri Extension, handing them out at the Ozark Empire Fair, and having them available as an on-line version. Various regional organizations mentioned the on-line survey in their newsletters.

Statistical analyses

Statistics were performed using Minitab version 14.1. Survey questions with answers left blank were eliminated from all analyses. Associations between responses were examined for multiple pairs of survey questions (Table 1) with Chi-square tests. Awareness of educational literature from agencies (question #2) was compared to litter usage (#3). Similarly, awareness of types of poultry litter (#1) was compared to litter usage (#3). Finally, county profiles were created by grouping county responses and tallying each desired response.

RESULTS AND DISCUSSION

Four hundred ninety-two surveys were returned from 16 counties in southwest Missouri. Total numbers of responses for each survey question are provided in Appendix 1. Of the respondents, 227 farmers (46%) have used poultry litter as a fertilizer on their

land. Most of the respondents used dry litter followed by wet. Litter was used mostly on pasture and hay (Appendix 1, #4).

The two biggest reasons for not using poultry litter were availability (20%) and convenience in getting it or transportation (16%). When asked to choose THE most important reason for not using poultry litter, availability was picked by 28% of respondents.

The following are summary statements of responses (Appendix 1).

1. Most respondents get their information on fertilizer from a fertilizer dealer (28%) followed by the University of Missouri Extension (21%) and agriculture publications (21%).
2. Most currently use a dry fertilizer (77%).
3. Hay production and pasture are the biggest uses of fertilizer in general (40% and 39%, respectively).
4. Most fertilizer is applied in the spring with March (39%) and April (24.5%) being the biggest months.
5. Most currently spend \$15 - \$30 per acre on fertilizer (46 %).
6. For those respondents who might like to try using poultry litter, availability (22%) is the biggest barrier to using poultry litter although there was a fairly even distribution of responses.
7. The majority of farmers are either somewhat (41%) or very aware (26%) of Nutrient Management Plans but only 128 (26%) have one.
8. Less than half have their soil tested on a regular basis (45%).

9. Most have internet access (62%), but only 7 (1%) have used litter/manure-related web sites.
10. The first choice in educational opportunities was receiving informational brochures (64%), with 40% interested in attending an educational program.
11. The vast majority of respondents would be willing to pay, for poultry litter, less than (43%) or about the same (38%) as they are paying for commercial fertilizer.
12. Only a small number of respondents is a member of the agriculture-related organizations listed. The largest group was the MFA with 37% of respondents being members.

Statistical Analyses

Respondents who were very aware and those who were somewhat aware of educational literature provided by the Natural Resources Conservation Service (NRCS) used poultry litter more frequently than expected (chi-square = 32.86, $p < 0.001$, Table 1). Respondents, who were very aware and somewhat aware of educational literature provided by the Missouri Department of Natural Resources, (MoDNR) used poultry litter more frequently than expected (chi-square = 41.296, $p < 0.001$, Table 1). Respondents, who were very aware or somewhat aware of literature provided by University of Missouri Extension, used poultry litter more frequently than expected (chi-square = 58.205, $p < 0.001$, Table 1).

Awareness of the various forms of poultry litter was associated with litter usage. Respondents who were 'very aware' of the uses of the various forms of poultry litter used

all forms more frequently than expected (Table 1). Those respondents who use poultry litter were more aware of Nutrient Management Plans than expected (chi-square = 37.679, $p < 0.001$, Table 1). Of the 227 farmers who use poultry litter, 80 also have a Nutrient Management Plan, while 148 do not have a NMP. The number who have an NMP was higher than expected (chi-square = 18.166, $p < 0.001$, Table 1). Finally, those farmers who have used poultry litter have their soil tested regularly more frequently than expected (chi-square = 9.599, $p = 0.002$).

Number of users, most used litter type, most frequent application type, and number of farms within three size ranges available for poultry litter application per county is provided in Table 2. Proportion of poultry litter users by county varies considerably by county (Fig. 1). For instance, Greene County has 88% more farms that do not use poultry litter, while Barry County has 82% more users than non-users. Some consistency exists among counties; however, as the most frequently used litter type in all counties is dry poultry litter (Table 2). While some counties have multiple types of applications most frequently used, pasture and hay appear to be the most frequent application types (Table 2). Those counties with ties in the frequency of application type had very low numbers of responses. Greene County has the largest number of farms available for litter application and potentially the largest acreage available for application. However, it is not surprising that Barry and McDonald Counties have the largest number of farmers who use poultry litter since the southwest corner of Missouri is where a large number of poultry producers are located. Again, perhaps availability and ease of transport are the biggest issues regarding use of poultry litter by farmers.

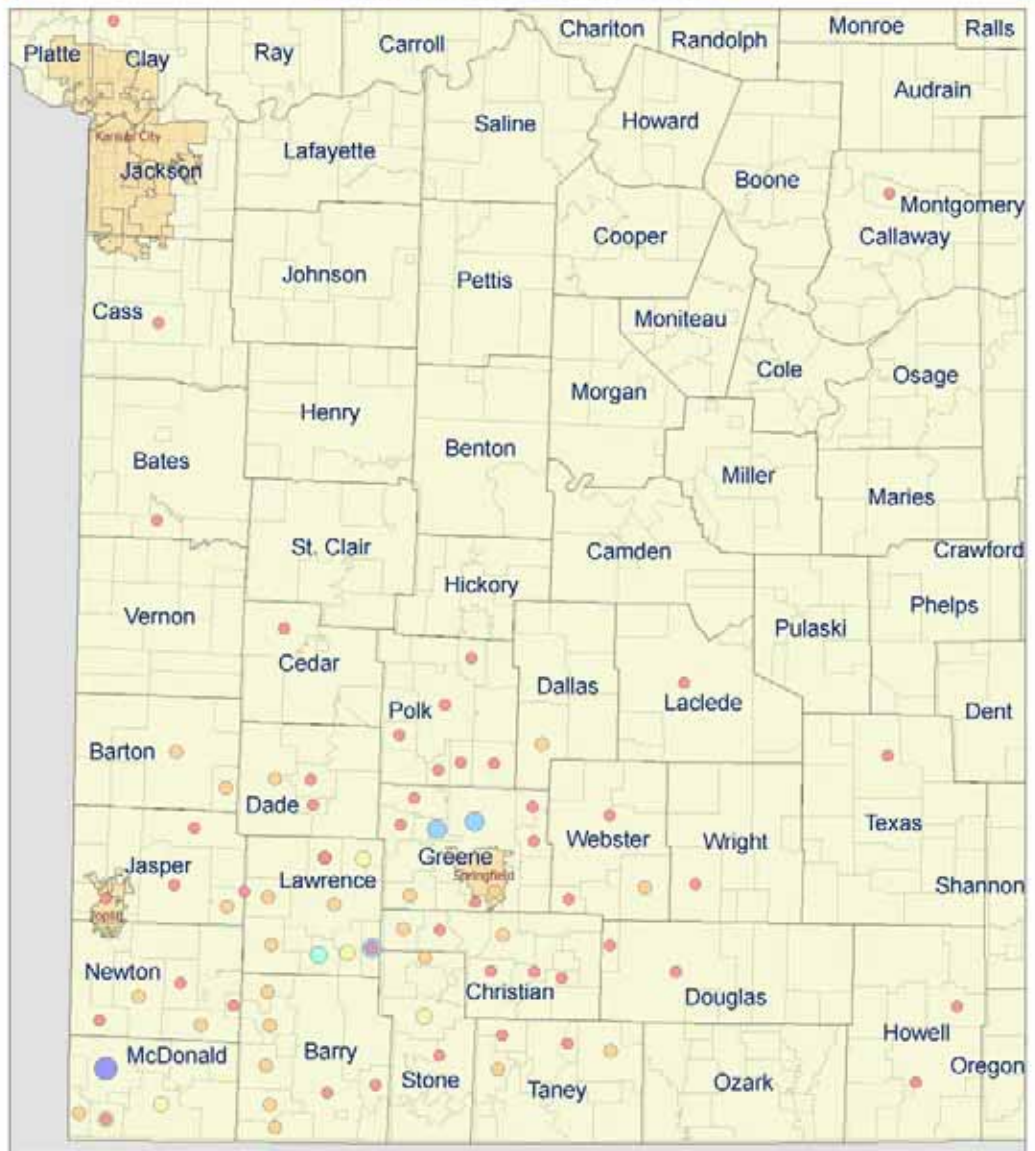
CONCLUSIONS

Approximately 40% of all respondents already use poultry litter mostly in the dry form. Availability and convenience in getting the litter to the farm are the biggest reasons people have not used it. If a cost-effective transportation system were developed, more farmers might use poultry litter.

Farmers are interested in learning more about using poultry litter. Informational brochures are the most preferred method, but 40% is also interested in attending an education program.

Location of Individuals Interested in Nutrient Management Educational Programs

Missouri Only, Two Individuals in Arkansas are Excluded

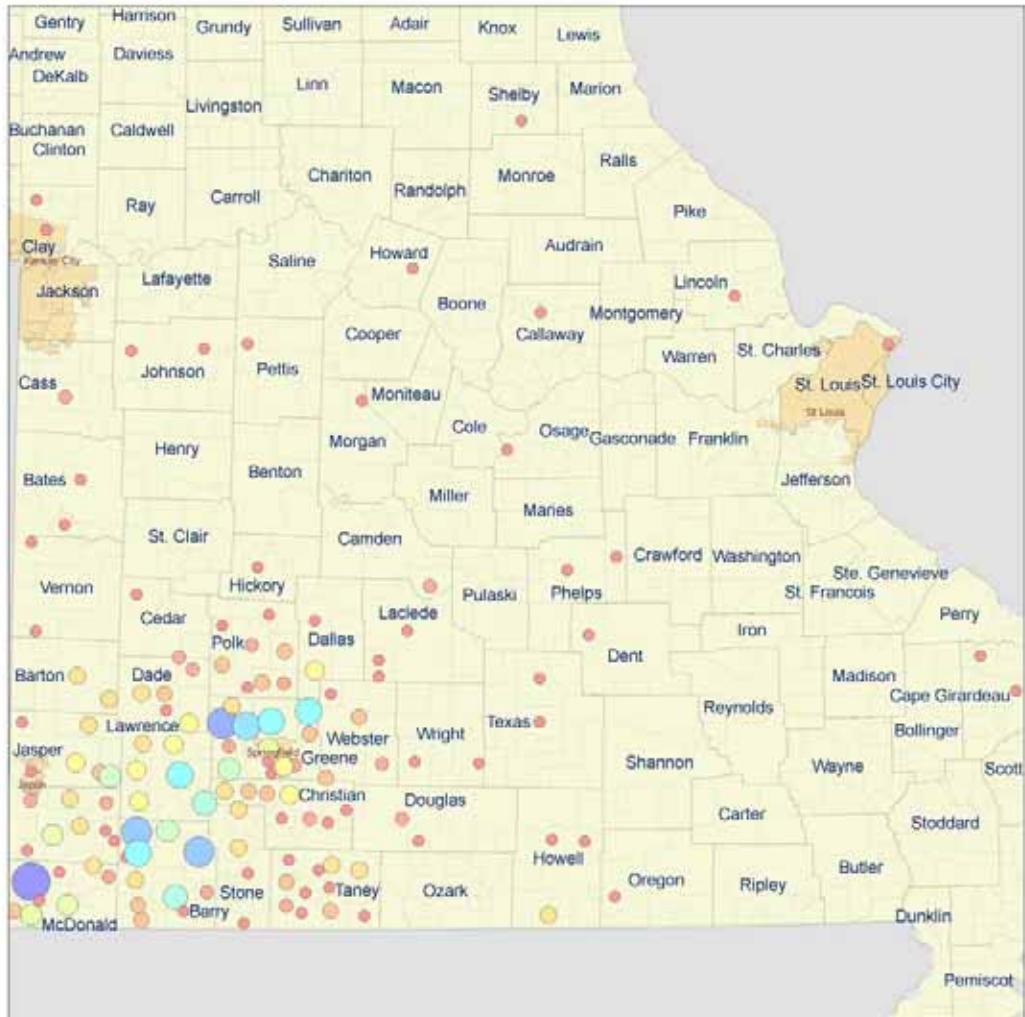


Individuals Per Zip Code



Location of All Individuals in Missouri Who Responded To Survey

Map does not include 4 Individuals in Arkansas, 1 Individual each in Kentucky, Illinois and Texas



Individuals Per Zip Code

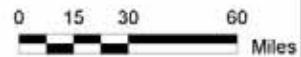


Table 1. Comparison of usage of poultry litter (question 3) with several other survey responses. Chi-square tests were performed on all response pairs. If $p < 0.05$, it is considered to be a statistically significant association.

Survey question	Survey response	Test statistic
Awareness of educational literature:		
2a	Natural Resources Conservation Service	chi-square = 32.863 ($p < 0.001$)
2b	Missouri Department of Natural Resources	chi-square = 41.296 ($p < 0.001$)
2c	University of Missouri Extension	chi-square = 58.205 ($p < 0.001$)
Awareness of uses of various forms of poultry litter:		
1a	Dry	chi-square = 111.895 ($p < 0.001$)
1b	Wet	chi-square = 42.502 ($p < 0.001$)
1c	Pellet	chi-square = 27.290 ($p < 0.001$)
1d	Ash	chi-square = 90.253 ($p < 0.001$)
16	Degree of awareness of Nutrient Management Plans	chi-square = 37.679 ($p < 0.001$)
17	Implementation of a Nutrient Management Plan	chi-square = 18.166 ($p < 0.001$)
18	Soil testing completed on a regular basis	chi-square = 9.599 ($p = 0.002$)

Table 2. Number of farmers who use poultry litter, most used poultry litter type, most frequent application type, and acreage available for application by county.

County	Use poultry litter	Don't use poultry litter	Most used litter type	Most frequent application type	Acreage available for poultry litter application		
					<100 acres	100-500 acres	>500 acres
Barry	49	11	dry	pasture	15	36	9
Barton	5	4	dry	row crops	1	2	4
Cedar	0	4	dry	row crops	1	1	2
Christian	3	19	dry	pasture/hay	9	10	3
Dade	7	14	dry	pasture	1	13	6
Dallas	4	3	dry	pasture	1	6	0
Greene	8	68	dry	pasture	36	36	3
Hickory	0	1	n/a	n/a	1	0	0
Jasper	10	7	dry	pasture	3	11	3
Lawrence	40	25	dry	pasture	20	37	7
McDonald	43	12	dry	pasture	22	30	3
Newton	15	7	dry	pasture	13	6	3
Polk	4	11	dry	pasture/grass production	9	3	3
Stone	12	8	dry	pasture/hay production	8	9	3
Taney	6	15	dry	horticultural crops/row crops	8	11	2
Webster	2	9	dry	pasture/hay production	5	6	0

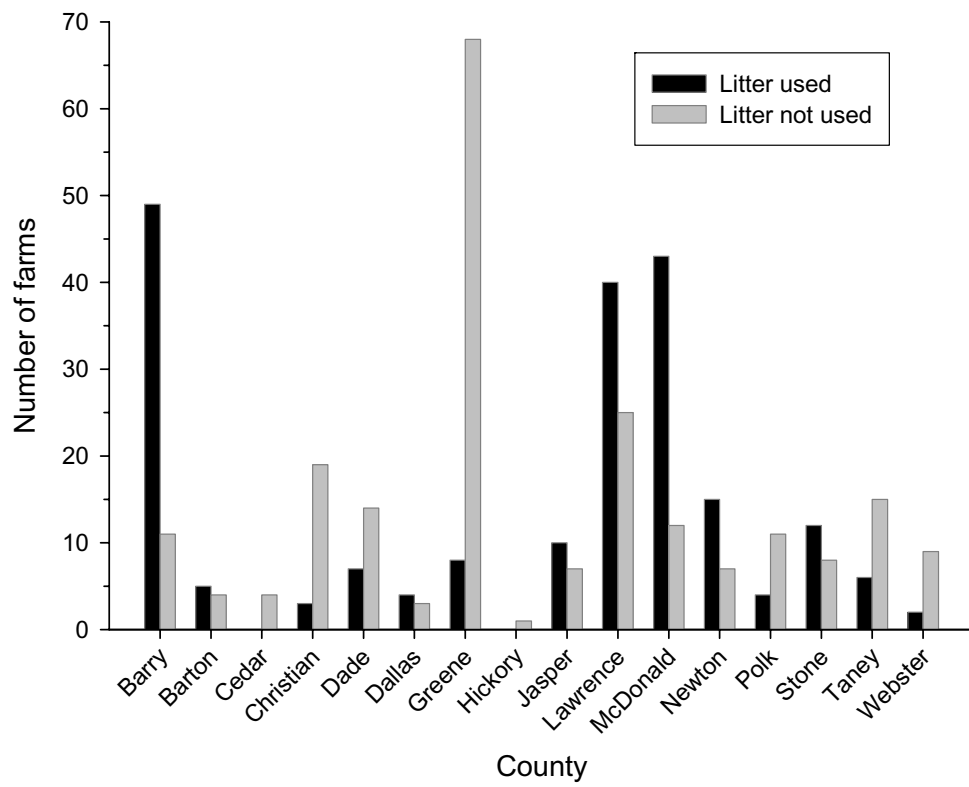


Figure 1. Number of farmers who use poultry litter and number of farmers who don't use poultry litter by county (Table 2).

REFERENCES

- Carlisle, N. 2003. Training called key to cutting poultry waste production. Springfield News-Leader.
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- McLaughlin, M.R., T.E. Fairbrother, and D.E. Rowe. 2004. Nutrient uptake by warm-season perennial grasses in a swine effluent spray field. *Agronomy Journal* **6**:484-493.
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- Robinson, J.S. and A.N. Sharpley. 1995. Release of nitrogen and phosphorus from poultry litter. *Journal of Environmental Quality* **24**:62-67.

APPENDIX 1. Survey Responses.

1. Please indicate how aware you are of the uses of the following forms of poultry litter:

	<u>Very aware</u>	<u>Somewhat aware</u>	<u>Not aware</u>
a. Dry	209	194	82
b. Wet	108	160	172
c. Pellet	38	132	261
d. Ash	14	84	326

2. Please indicate how aware you are of current educational literature on the use of poultry litter from the following agencies.

	<u>Very</u>	<u>Somewhat</u>	<u>Not</u>
a. Natural Resources Conservation Service	84	143	245
b. Missouri Department of Natural Resources	60	142	253
c. University of Missouri Extension	98	157	200

3. Have you ever used poultry litter as fertilizer on your land?

- a. Yes 227
b. No 264

If YES, how many years have you been using poultry litter?

See Appendix 2.

4. Please indicate how you have used each of the following types of litter (choose all that apply):

	Row	Pasture	Hort crops	Hay	Grass seed	Not
a. Dry	32	179	16	155	51	278
b. Wet	13	59	3	49	9	420
c. Pellet	3	3	1	5	1	485
d. Ash	0	2	0	0	0	490

5. If you have not used poultry litter, please indicate why not (choose all that apply):

- a. Cost 35
b. Odor 66
c. Time to investigate its use 64
d. Neighbors won't like it 46
e. Time to locate it 68
f. Lack of application equipment 91
g. Convenience in getting it or transportation 107
h. Availability 136
i. Other 55

6. Please indicate below THE most important reason you do not use poultry litter (choose only one response):

a. Cost	15
b. Odor	24
c. Time to investigate its use	28
d. Neighbors won't like it	14
e. Time to locate it	10
f. Lack of application equipment	17
g. Convenience in getting it or transportation	47
h. Availability	77
i. Other	43

7. Where do you get your information about fertilizer?

a. Agriculture publications	197
b. USDA-Natural Resource Conservation Service	113
c. Fertilizer dealer	267
d. University of Missouri Extension	204
e. Agronomist	76
f. Internet	33
g. Other	66

8. Please indicate what kinds of commercial fertilizer you currently use:

	Use	Don't use
a. Liquid	56	436
b. Dry	413	78
c. Combination	23	469
d. Anhydrous ammonia	22	470
e. Other	19	

9. Please indicate what you use commercial fertilizer for:

a. Row crops	54
b. Hay production	365
c. Horticultural crops	30
d. Pasture	356
e. Grass seed production	96
f. Other	13

10. When do you apply most fertilizer on your land?

a. Winter	36
b. Spring	382
c. Summer	25
d. Fall	121

11. Which month do you most heavily use commercial fertilizer?

- | | |
|----------------|-----|
| a. Jan | 1 |
| b. Feb | 37 |
| c. Mar | 192 |
| d. April | 121 |
| e. May | 24 |
| f. June | 5 |
| g. July | 3 |
| h. Aug | 10 |
| i. Sep | 13 |
| j. Oct | 7 |
| k. Nov | 2 |
| l. Dec | 5 |
| m. No response | 72 |

12. What nutrient levels and amounts do you currently or most commonly use in commercial fertilizers?

- | | <u>N</u> | <u>P</u> | <u>K</u> | <u>Mic</u> | <u>Tot</u> | <u>Number</u> |
|-----------------------|----------|----------|----------|------------|------------|---------------|
| a. Fertilizer blend 1 | | | | | | |
| b. Fertilizer blend 2 | | | | | | |
| c. Fertilizer blend 3 | | | | | | |

13. Please indicate how much you currently spend annually on fertilizer:

- | | |
|------------------------|-----|
| a. 0-\$50/acre | 65 |
| b. \$15-\$30/acre | 225 |
| c. \$30-\$45/acre | 90 |
| d. More than \$45/acre | 18 |
| e. No response | 94 |

Poultry litter can be a good source of the macronutrients needed by agricultural crops. Poultry litter can have 60-80 pounds of elemental nitrogen per ton, 70-90 pounds of phosphate (P₂O₅) per ton and 45-65 pounds of potassium (K₂O) per ton. In addition poultry litter also contains many other nutrients needed by crops such as calcium, sulfur, magnesium, copper, and zinc as well as carbon in the form of organic matter.

14. If you would like to try using poultry litter on your land, after reading the above statement, what would be your barriers to using it?

a. Transportation difficulty	189
b. Lack of application equipment	152
c. Timing of getting and applying litter	172
d. Odor	100
e. Storage	54
f. Neighbors won't like it	108
g. Cost	108
h. Availability	188
i. Other	54

15. If you would like to try using poultry litter on your land, what would be THE biggest barrier to you?

a. Transportation difficulty	66
b. Lack of application equipment	59
c. Timing of getting and applying litter	62
d. Odor	37
e. Storage	6
f. Neighbors won't like it	17
g. Cost	44
h. Availability	83
i. Other	39
j. No response	79

16. Please indicate how aware you are of Nutrient Management Plans?

a. Very aware	130
b. Somewhat aware	200
c. Not aware	152
d. No response	10

17. Do you have a Nutrient Management Plan?

a. Yes	128
b. No	364
c. No response	10

18. Do you have your soil tested on a regular basis?

a. Yes	298
b. No	364

How often do you have your soil tested?

See Appendix 2.

Do you follow soil test recommendations?

Yes	387
No	105

19. Do you have internet access?

- a. Yes 307
- b. No 185

20. Have you used the following Internet web sites?

	<u>Y</u>	<u>N</u>
a. Missouri Litter Market Exchange	7	485
b. Missouri Manure Management Action Group	7	485

21. Would you be interested in any of the following educational opportunities to learn more about using poultry litter?

	<u>Y</u>	<u>N</u>
a. Talking with other farmers who have used poultry litter	165	327
b. Attending an educational program	197	295
c. Receiving informational brochures	313	179

22. After reading the statement before questions #14 about the nutrients found in poultry litter, what would you be willing to pay for poultry litter if spreading were included?

See Appendix 2.

23. After reading the statement before question #14 about the nutrients found in poultry litter; what would you be willing to pay LESS THAN, ABOUT THE SAME, SLIGHTLY MORE, for poultry litter compared to commercial fertilizer:

- a. Less than 213
- b. About the same 186
- c. Slightly more 42
- d. No response 51

The following information will be used to help determine if a representative sample of the agriculture community completed the survey. No information will be presented that in any way identifies an individual.

24. How much land do you have that poultry litter could be used on?

- a. Less than 100 acres 187
- b. 100-500 acres 239
- c. More than 500 acres 57
- d. No response 9

25. What is your age?		
a.	20-30 years	34
b.	30-40 years	48
c.	40-50 years	112
d.	50-60 years	124
e.	Over 60 years	169
f.	No response	9

26. What county in Missouri is your farm located:		
a.	Barry	60
b.	Barton	9
c.	Cedar	4
d.	Christian	22
e.	Dade	21
f.	Dallas	7
g.	Greene	76
h.	Hickory	1
i.	Jasper	17
j.	Lawrence	65
k.	McDonald	55
l.	Newton	22
m.	Polk	15
n.	Stone	20
o.	Taney	21
p.	Webster	11
q.	Other	54
r.	No response	12

27. Are you a member of any of the following organizations?			
		Yes	No
a.	Missouri Cattlemen's Association	110	382
b.	Missouri Corn Grower's Association	8	484
c.	Missouri Farmers Union	5	487
d.	Missouri Soybean Association	16	476
e.	Missouri Farm Bureau	132	360
f.	MFA	182	310