Iowa Beef Center

Gaining value from beef feedlot manure

Russ Euken

Iowa State University

Manure from beef feedlots

- What is manure worth to your operation?
  - $10/head
  - $20/head
  - $30/head
  - Less
  - More
- Can you make money spreading manure?

Manure from beef feedlots

Nutrients in feed

-Nutrients retained by animal

=**Nutrients excreted**

-Nutrients lost – facility, weather, etc etc

=**Nutrients captured in manure**

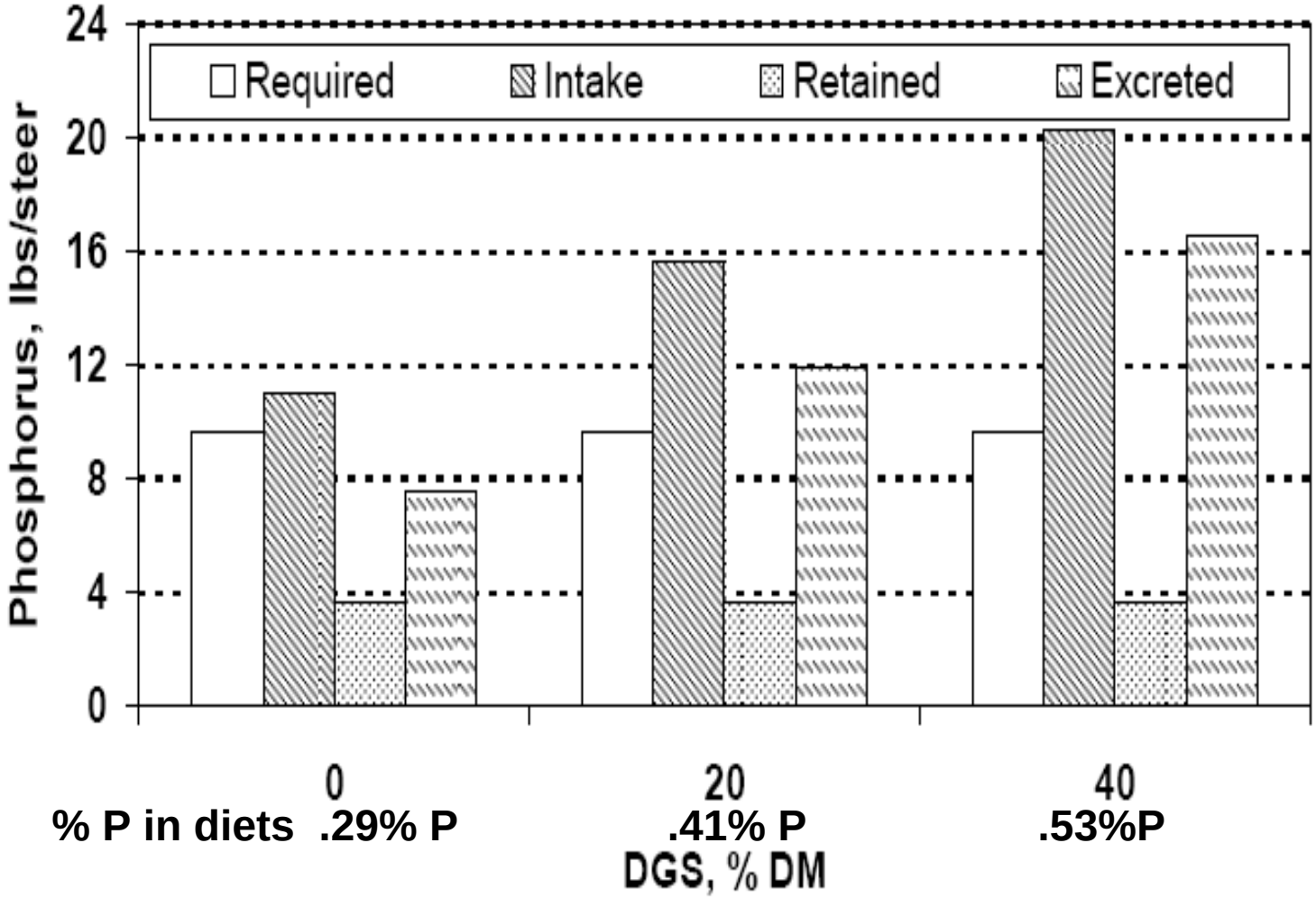
-Nutrients lost or unavailable after application

=**Nutrients available to crops**

Manure from beef feedlots

- About 10 -20 % of N and P fed in diet is retained in beef feedlot animal
  - Varies with diet and animal
  - The rest is excreted

Manure from beef feedlots



Manure from beef feedlots

Raw manure varies with diet and cattle size but on average per day

- 64 lbs / 1000 lb animal @ 92 % moisture
  - .38 lbs N
  - .15 lbs P_2O_5
  - .30 lbs K_2O per lb.

» ASAE D384.2

Manure from beef feedlots

Finishing beef (153 days)
as excreted (92% moisture)

9800 pounds manure

	12.6 % CP .35% P	16 % CP .5% P
Lbs N	60	79
Lbs P_2O_5	23	34
Lbs K2O	46	46 ??

Manure from beef feedlots

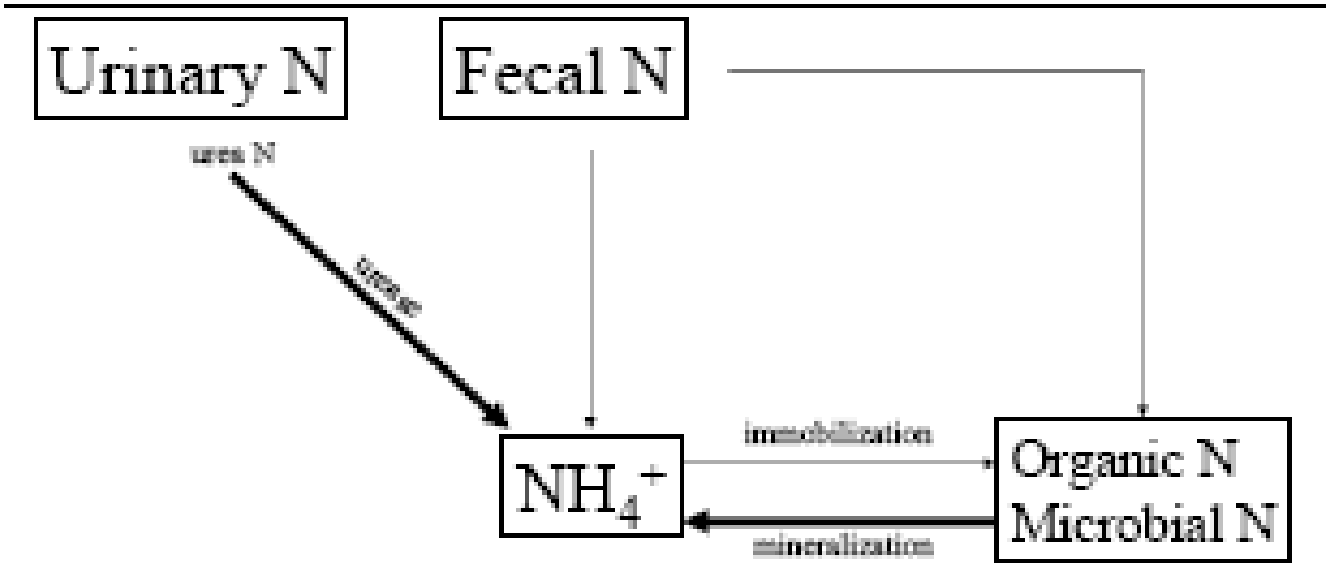
Raw manure varies with diet and cattle size but on average per day

- 64 lbs / 1000 lb animal @ 92 % moisture
  - .38 lbs N - 137 lbs/ year /space
  - .15 lbs P_2O_5- 54 lbs /year/space
  - .30 lbs K_2O - 108 lbs/ year/space
    - » ASAE D384.2

Manure from beef feedlots comparing facilities

- Open lot
  - Earth lot
  - Concrete lot
    - Runoff controls
- Deep pit confinement barns
- Bedded confinement facilities

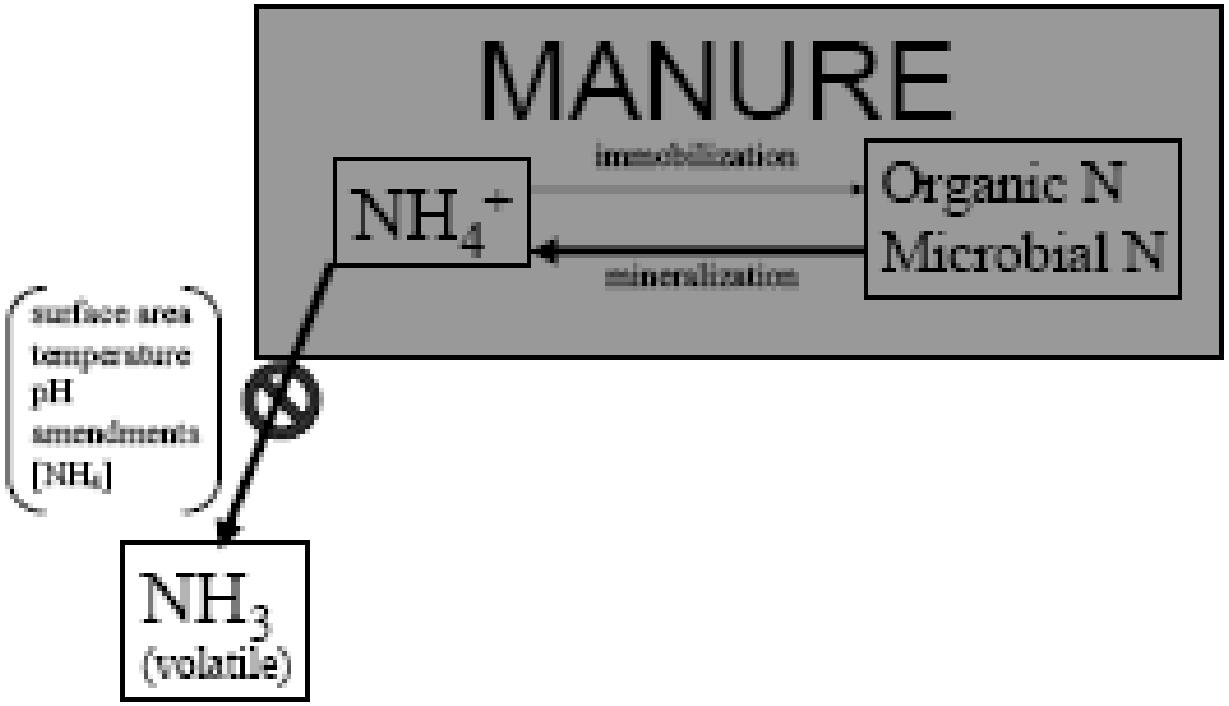
Manure nitrogen



Nitrogen losses

- To the air
  - N (Urea) conversion to Ammonia
    - Happens fastest under warm, moist, aerated conditions
    - Control with frequent scraping, stockpiling, and incorporation

Manure nitrogen



What does not volatilize stays in manure

Nutrient losses

- To runoff water
  - N, P and K
    - Control with clean water diversion, frequent scraping, stockpiling, settling basins, and runoff control basins

Open lot management

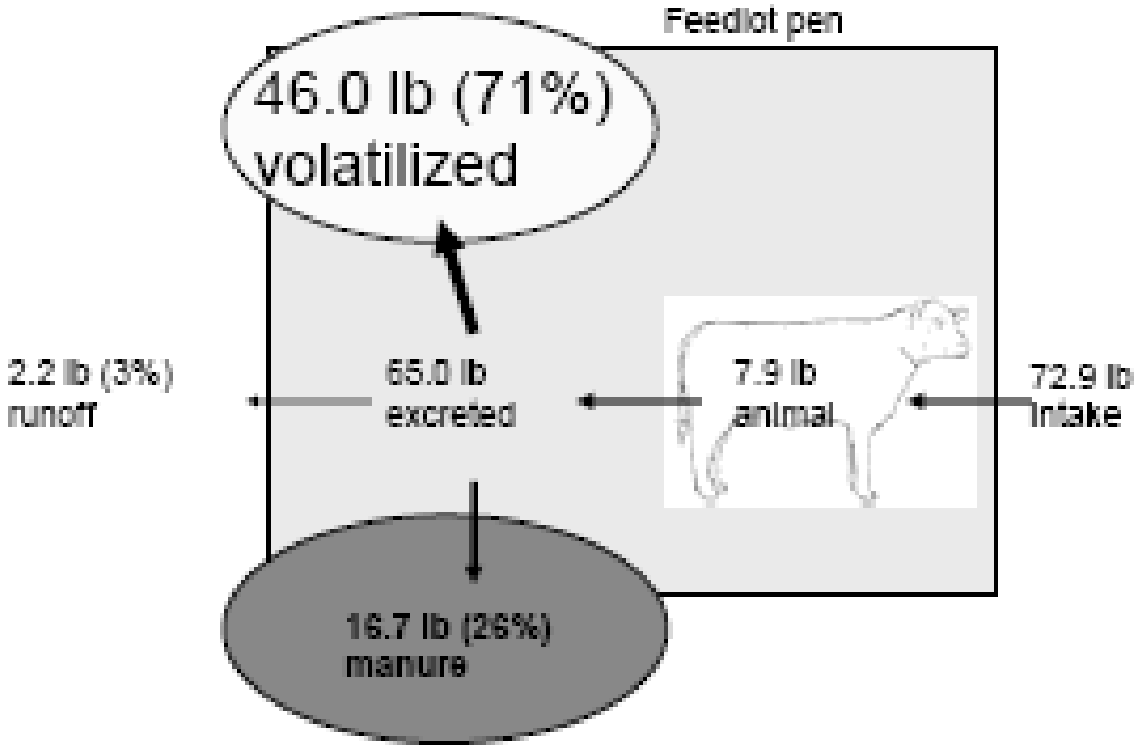
VariaBiLity

Biggest Variable???

- Moisture!
  - Bedding
  - Added soil

N loss in open lot

Average diet N, 13.5% CP
Summer-Yearlings



Decreasing surface area
Cleaning frequency

Item	2001		2002	
	Monthly	End	Monthly	End
DM	1464	803	1529	1103
OM	440	230	449	269
N manure	21.3	12.6	21.3	15.8
N loss	36.9	45.6	26.6	33.6
N loss, %	63.6	78.4	55.5	68.0

2001 54 pens, 1.45 – 1.57% N
2002 48 pens, 1.39 – 1.43% N

Manure from beef feedlots

- Open lot management
  - Up to 70% of N volatilized in summer and 40% in winter
  - More frequent cleaning
    - Earth lots - 13 % less loss of N with monthly versus end of feeding period cleaning – More manure also- U of Neb 2004 beef research report
  - Divert water

Lorimor Data on open beef feedlots 5 feedlots

21 lbs of manure/head/day at 68 % moisture – 43 % CV

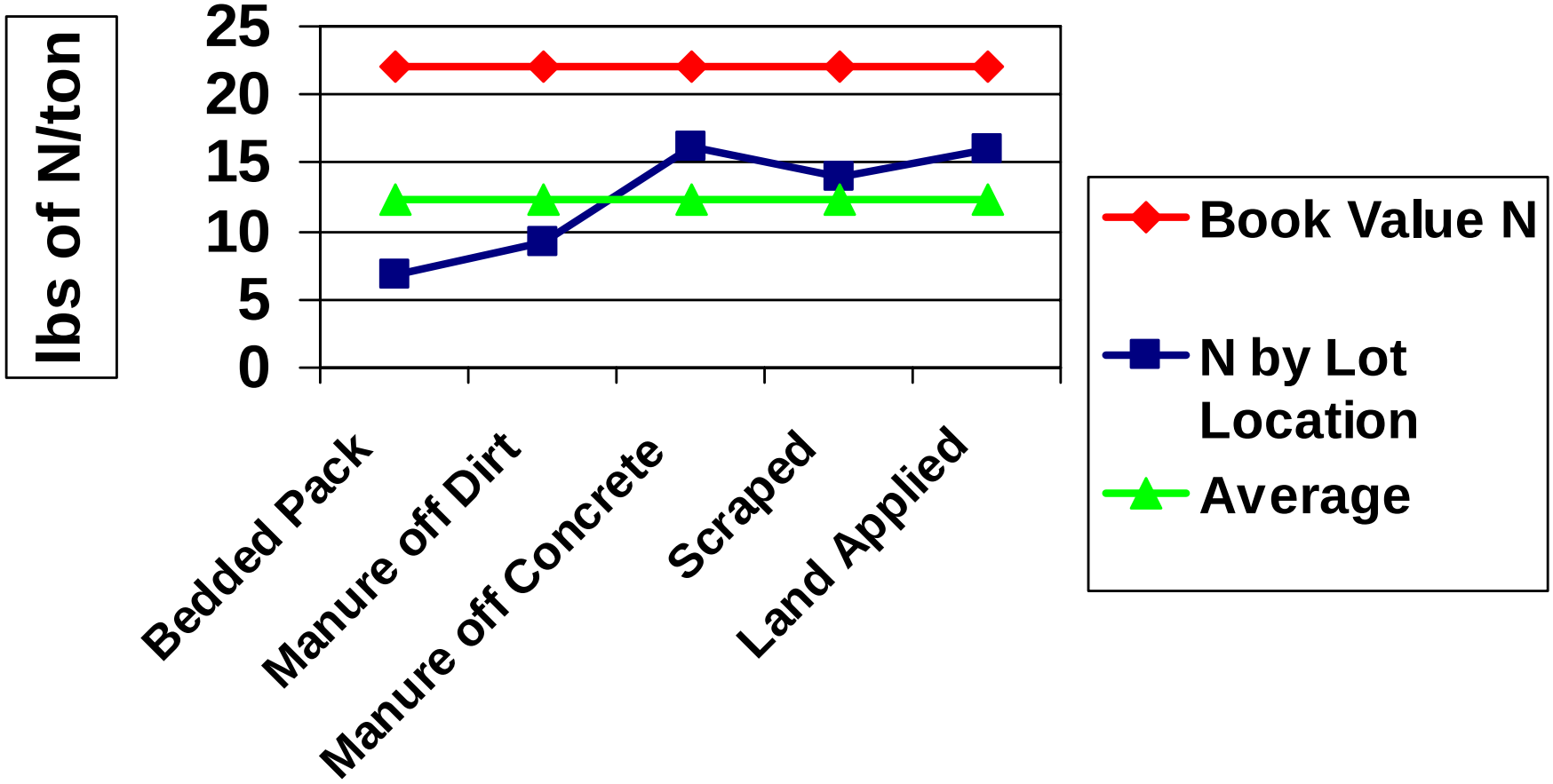
3.75 tons per space per year

	lbs/ton	lbs/year calc	CV
N	10.2	38.25	63 %
P2O5	6.8	25.5	71 %
K2O	34	127.5	161%

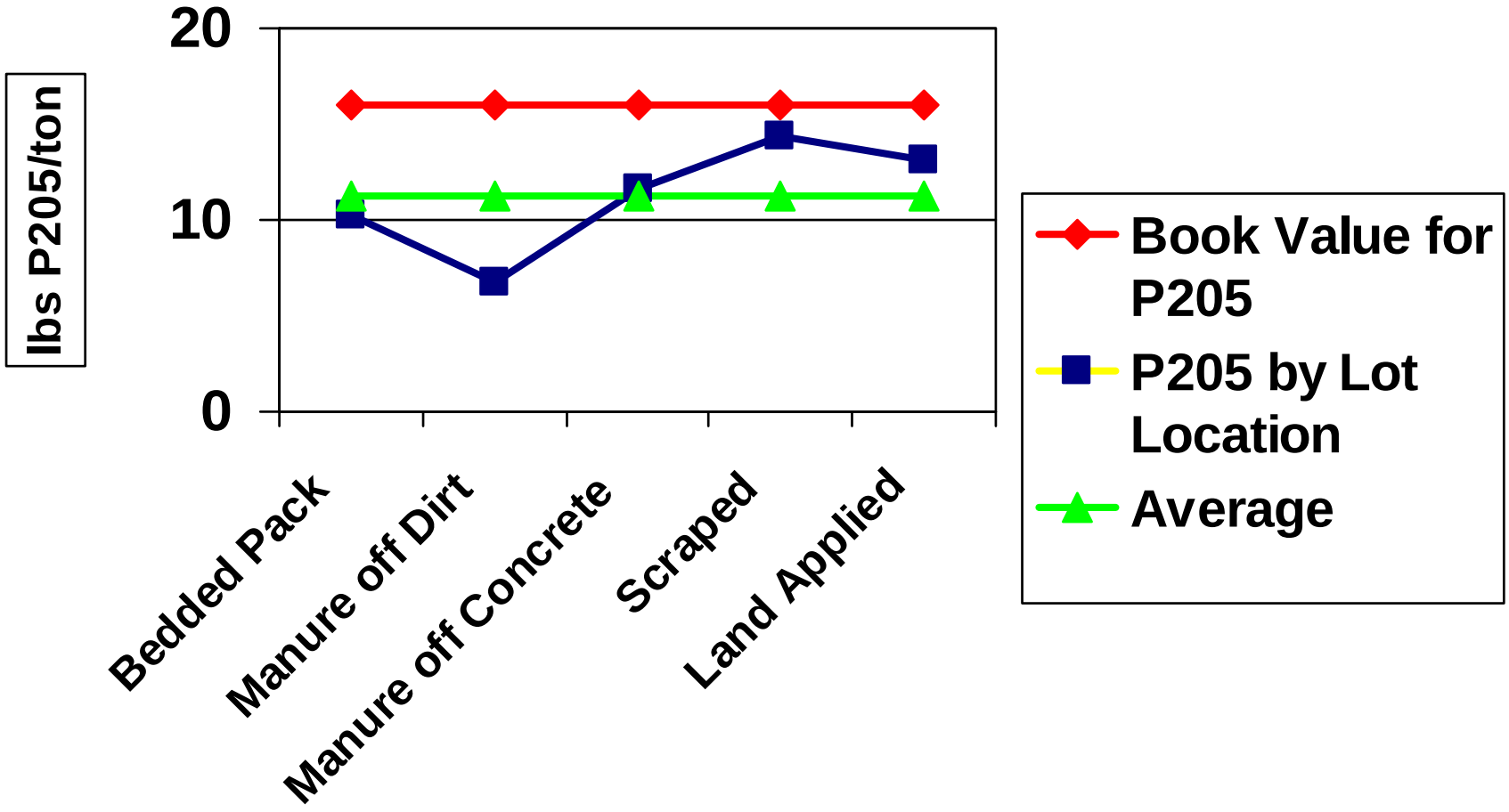
2006 Nebraska Beef Cattle Report Summary of Manure Amounts, Characteristics, and Nitrogen Mass Balance for Open Feedlot Pens in Summer Compared to Winter
118 research trials on earth lots

	Summer	Winter
Avg manure lbs/hd/day	Avg 15 lbs at 69.6% DM 3.5-35.7 range	Avg 31.9 lbs at 61.4% DM 31.5-76.9 range
Yearly manure	1.36 ton/space/year	2.91 ton/space/year
N lbs/hd/day	.13 avg Range .03-.27	.22 avg Range .04-.36
N pounds per 6 months avg.	23.7	40
N pounds per ton	17.4	13.75
% N volatilized	69% avg 38-98 range	47 % avg 10-89 range

Open Lot Beef N Samples



Open Lot Beef P_2O_5 Samples



Manure from beef feedlots

- Deep pit beef facilities
  - 6.5 gallon per head per day- 60 lbs
    - 2340 gallons per space per year

	Lbs/ 1000 gal	Lbs/space/year
N	40	94
P_2O_5	25	59
K_2O	35	82

Manure from bedded confinement

- Sampled hoops and monoslopes
  - Varied management
- 11 different operations- Approx 60 samples
- Jan- July 08
- Apron, Pack, Stockpile locations sampled separately

Analyzed for moisture, N, P, K, S some for ammonia

Manure from bedded confinement nutrient analysis

	Avg.	CV
% DM	30	12
Total N	18.5	21
Ammonia	4.6	65
P2O5	9.9	29
K2O	11.8	26
S	2.4	21

Amount of manure from bedded confinement - calculated

- One head for one year
  - 21000 lbs manure at 92 % moisture
    - 2190 lbs bedding at 20 % moisture 6 lbs/day
  - 23000 lbs at 85 % moisture
- Adjusted to 70 % moisture
  - 11328 lbs – 6 ton of manure at 30 % DM

Manure from bedded confinement

- Raw manure- as excreted per day
  - Total lbs. per year per space 20880

	N	P2O5	K2O	S
	122.4	75.6	93.6	16.2

  - Cornstalks – 6 lbs/hd/day added-
    - 2160 lbs per year per space

	N	P2O5	K2O	S
	13.8	6.5	29	2.4
Total	136.2	82.1	112.6	18.6

Manure from bedded confinement nutrient analysis

By location of sample

-Pack, apron and stockpile were all similar- Stockpiles and aprons were a little wetter

By operation

- Not as much variation between samples from one operation

- With the exception of one - operation averages were all similar to overall avg.

Manure from bedded confinement nutrient analysis

	Avg. lbs/ton	Lbs per year @ 6 ton
Total N	18.5	111
P2O5	9.9	60
K2O	11.8	71

Manure from beef feedlots

Summary Nutrients per space per year

Facility	Total N lbs/space/year	P2O5 lbs /space/year	K2O lbs/space/year
Open lot- ASABE and ISU Runoff not included	66	48	54
Bedded confinement- w/o nutrient additions from bedding	98	57	58
Deep pit	94	59	82
Excreted	122	68	93

Sampling and analysis of beef feedlot manure

Test your manure!

- Moisture, total N, P, K (around $30 test)
- Take good representative samples
- Make note of variability by source & season

Ammonia analysis??

Ash analysis??

Manure nutrients from feedlots- Land application

Stored manure – stockpiled or compost

Nutrient availability – mainly nitrogen

Application- Timing, method, Rate, Match crop needs, calibration, and uniformity

Solid Manure Storage

- Fresh

- Stockpile

- Compost

- Nitrogen
  - Fresh > Stockpiled > Composted
  - Larney et al., 2006
- Nutrient recoveries in finished compost is greater when OM is increased
  - Adams et al., 2004; Ferran et al., 2

Manure nutrients from feedlots- Storage?

Stored solid manure – stockpiled or compost allow for more timely application??

Stockpiled manure – more volume more N regulations??

Compost less volume and less N

Manure storage

	Compost	Stockpile
% N retained	56%	86%

After 104 days

Increase in organic N in compost relative to stockpile and increase in ammonium N in stockpile

U of Neb Beef Research report 2009

Manure nutrients from feedlots- Land application

Application- Calibration and Consistency

Manure application rates

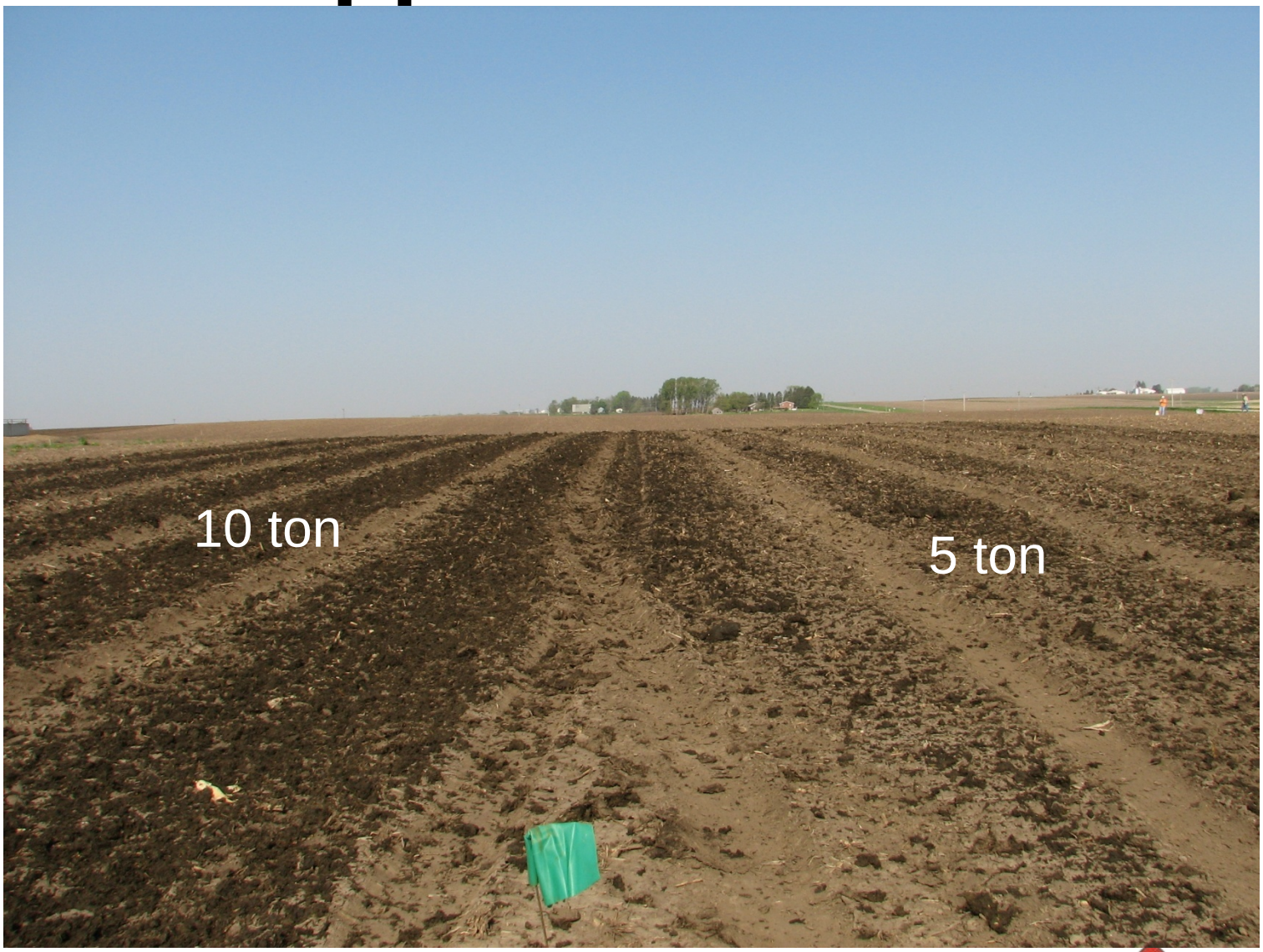
Manure application rates

40 ton

10 ton

Application rates

Application rates



Manure nutrients from feedlots- Land application

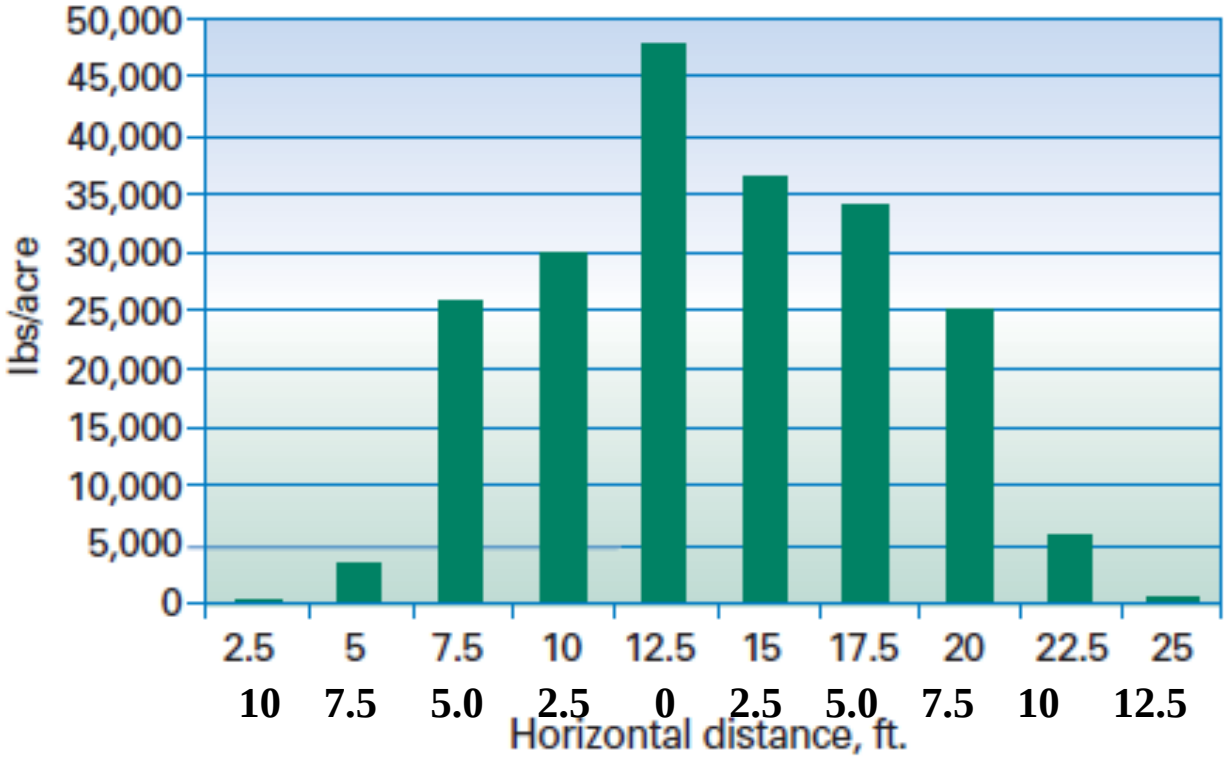
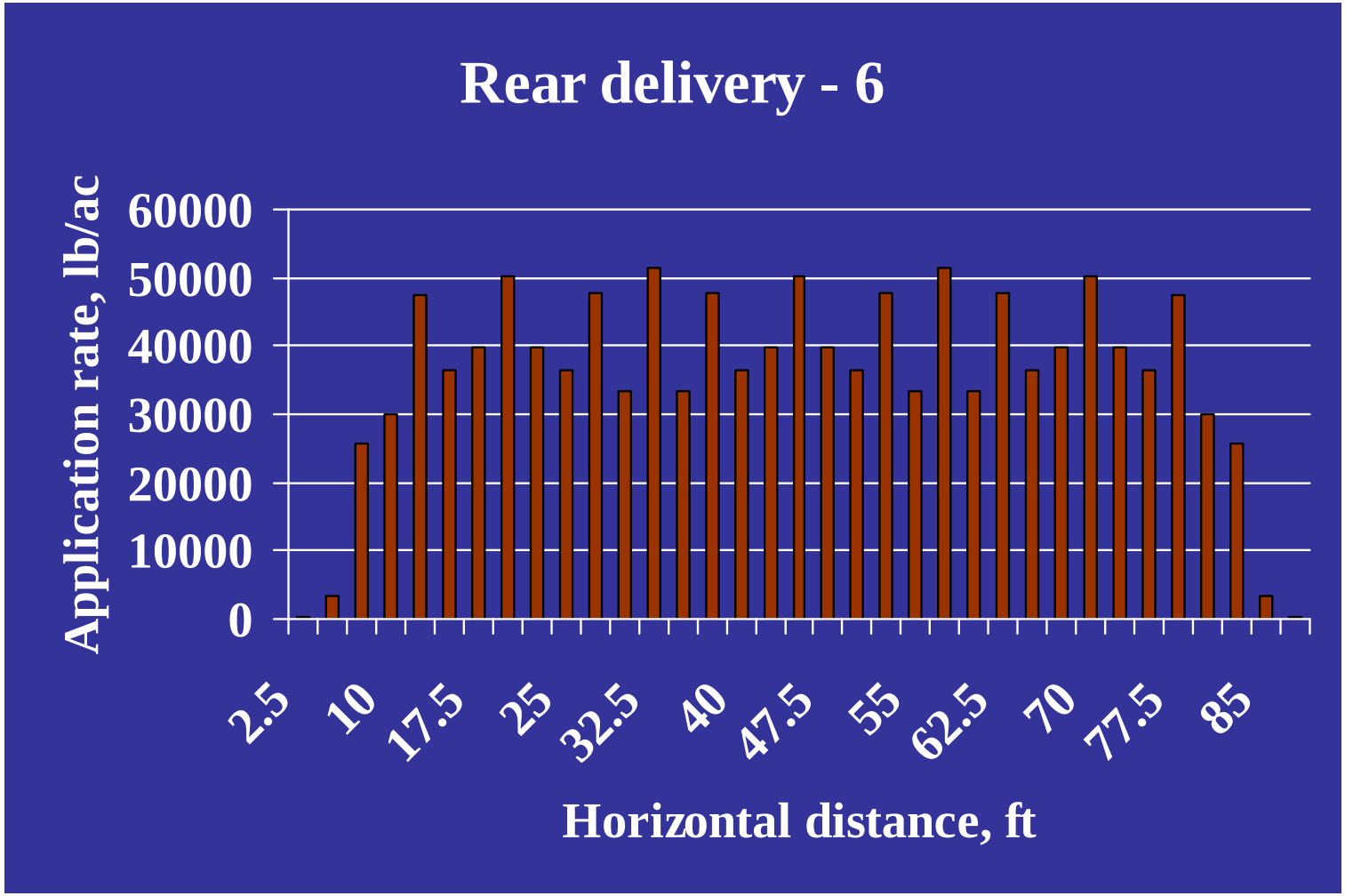


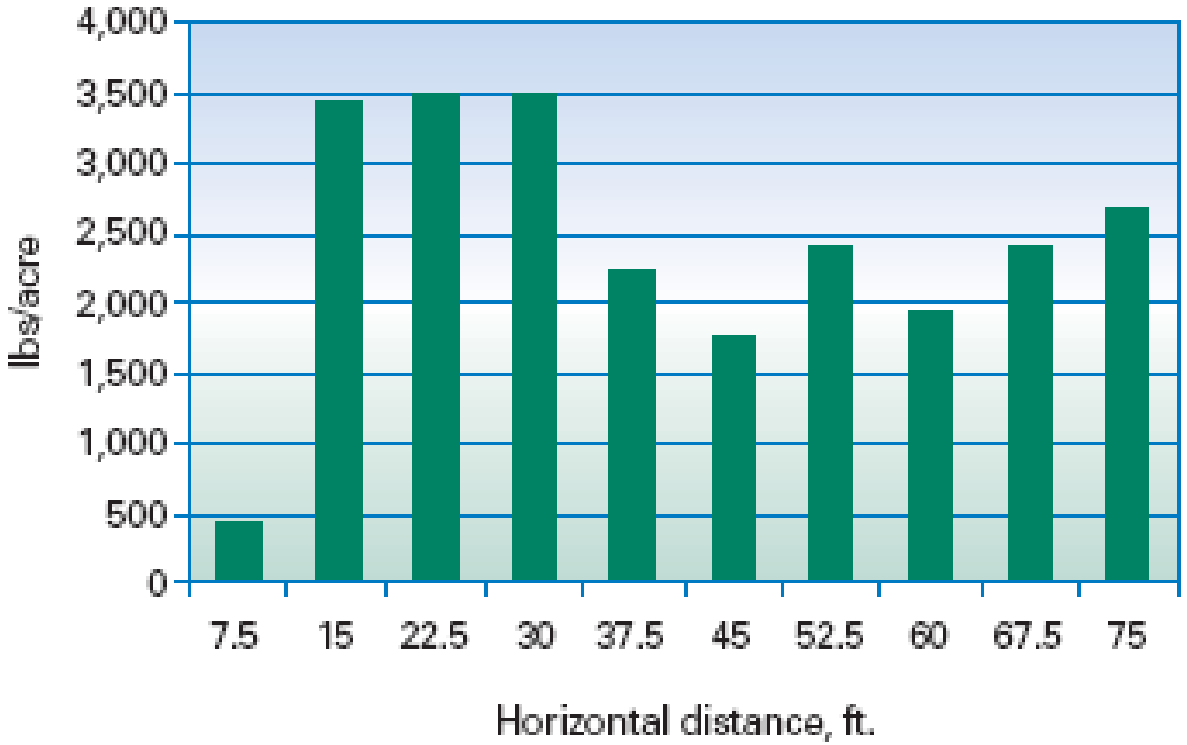
Figure 2. Typical single-swath pattern for a rear-beater spreader.

Uniformity of spread



Rate and uniformity

Figure 5. Side-delivery spreader.



Manure nutrients from feedlots- Land application

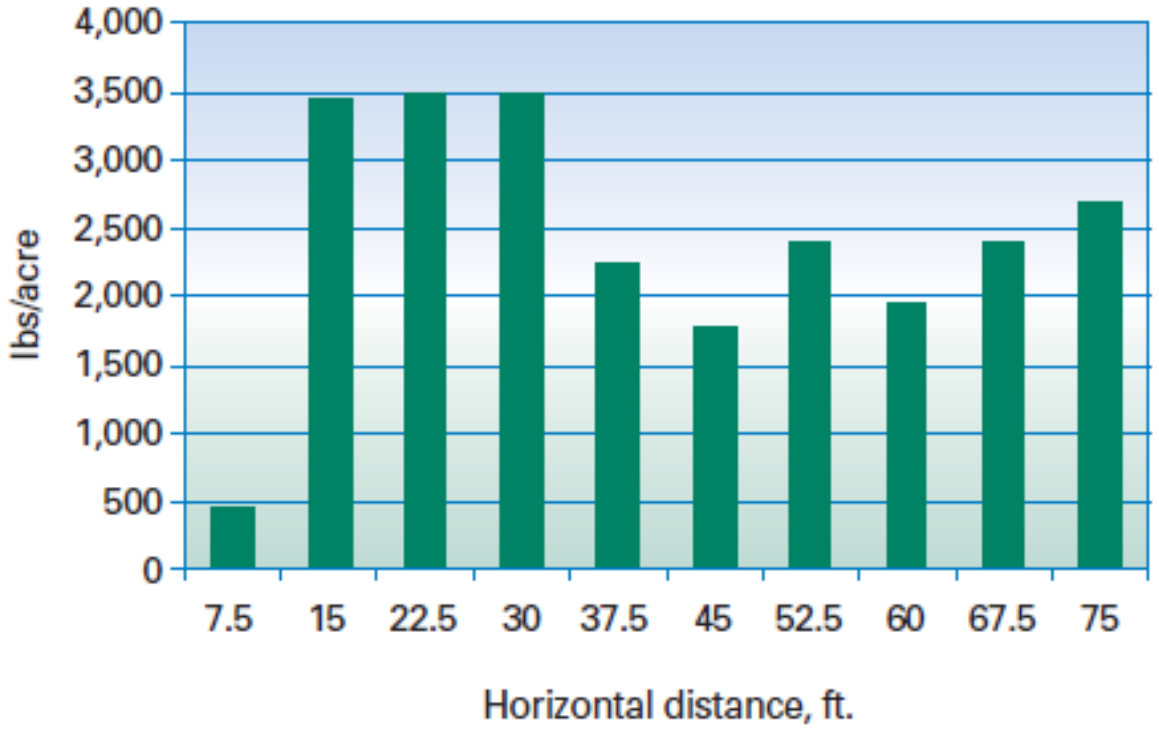


Figure 6. Typical single-swath pattern for side-delivery spreader.

Manure nutrients from feedlots- Land application

Nutrient availability – PMR 1003 Using manure nutrients for crop production

Nitrogen – Inorganic and Organic form

- Inorganic is ammonium available to crop
- Organic needs to be mineralized to be available

Manure nutrients from feedlots- Land application

Availability – Pm 1003

Feedlot solid manure –

30-40 % 1st year availability of N

10 % 2nd year

5 % 3rd year

Some of the N doesn't break down and becomes part of organic matter

Manure nutrients from feedlots- Land application

Availability Pm 1003

Feedlot solid manure – nutrient availability

60-100 % P_2O_5 and 90-100 % of K_2O

Lower soil tests = less available

High soil tests and history of manure use 100%

Manure nutrients from feedlots- Land application

Application rate- Timing, method

Spring or fall?

Incorporated or not incorporated

95-100% of N if incorporated in 1 day

70-85 % of N without incorporation

Manure nutrients from feedlots- Land application

180 bu. continuous corn –

190 lbs N, 67lbs P_2O_5, 54 lbs K_2O

w/stalk removal 80 lbs P_2O_5, 126 lbs K_2O

Feedlot manure nutrients /ton

21 lbs N- 8lbs available, 12 lbs P_2O_5 and 14 lbs K_2O

What rate?

Manure nutrients from feedlots- Land application

180 bu. continuous corn –

190 lbs N, 67lbs P_2O_5, 54 lbs K_2O

with stalk removal 80 lbs P_2O_5, 126 lbs K_2O

25 ton = 200 lbs N, 300 lbs P_2O_5, 350 lbs K_2O

15 ton = 120 lbs N, 180 lbs P_2O_5, 210 lbs K_2O

5 ton = 40 lbs N, 48 lbs P_2O_5, 56 lbs K_2O

Manure nutrients from feedlots- Land application

21 lbs N, 12 lbs P_2O_5 and 14 lbs K_2O per ton

500 head capacity @ 6 ton = 3000 ton
200 head capacity @ 3 ton = 600 ton

25 ton =200 lbs N 1st yr, 300 lbs P_2O_5, 350 lbs K_2O

3600 ton/25 ton = 144 acres

Manure from feedlots land application

Assume $.28 lb N, $.55 P_2O_5 and $.65 K_2O

- Potential value
  - $18.78 per ton or @ 25 ton per acre $465.50/acre

Manure from feedlots land application

4 years of corn

	N lbs	P2O5 lbs	K2O lbs	
Manure nutrients available	190	300	350	
Commercial fertilizer applied	0	0	0	
Crop use	190	80	126	Total
Excess or deficient	0	220	224	Value/ yr
Manure nutrients value	$53.20	$44.00	$81.90	$179.10

	N lbs	P2O5 lbs	K2O lbs	
Manure nutrients available	47.5	220	224	
Commercial fertilizer applied	142.5	0	0	
Crop use	190	67	54	Total
Excess or deficient	0	153	170	Value /yr
Manure nutrients value	$13.30	$36.85	$35.10	$85.25

Manure from feedlots land application

4 years of corn

	N lbs	P2O5 lbs	K2O lbs	
Manure nutrients available	24	153	170	
Commercial fertilizer applied	166	0	0	
Crop use	190	67	54	Total
Excess or deficient	0	86	116	Value/yr
Manure nutrients value	$6.72	$36.85	$35.10	$78.67

	N lbs	P2O5 lbs	K2O lbs	
Manure nutrients available	0	86	116	
Commercial fertilizer applied	190	0	0	
Crop use	190	67	54	Total
Excess of deficient	0	19	62	Value/yr
Manure nutrients value	$0.00	$36.85	$35.10	$71.95

Manure rate

- Apply rate that uses some commercial N and some manure N?
- Take credit for P and K
- Costs of application

Other considerations

Not all land owners may be willing to pay for excess nutrients beyond next year's need

Also consider other impacts and application cost

- Organic matter value
- Compaction
- Timeliness
- Application cost (distance hauled- rate applied)

Plot data

- Manure plot – applied this spring
  - 5, 10 and 20 ton of bedded manure and 200 lbs commercial N side dressed.
  - Each treatment replicated 2x

Plot data with bedded manure

Manure tons applled	Total N applied	Calculated N lbs.available	Spring ntirate test ppm	Stalk test ppm	Yield bu. per acre	before manure app P2O5 ppm	K2O ppm
0	200 lbs	200	6	1220	226	40	234
0	200 lbs	200	6	559	209	70	268
				Avg.	**217.5**		
5 ton	130	49.4	7	<20	138	31	205
5 ton	130	49.4	10	55	136	55	236
				Avg.	**137**		
10 ton	260	98.8	6	<20	164	60	267
10 ton	260	98.8	8	<20	172	51	248
				Avg.	**168**		
20 ton	520	197.6	10	<20	212	45	222
20 ton	520	197.6	8	<20	228	56	219
				Avg.	**220**		

Manure rules

All manure application must follow 200 foot separation distance from water sources (wells, lakes, streams) unless incorporated same date

Confinement beef operations over 500 head and total beef capacity over 1000 head are subject to other rules and regulations (Iowa Manure Management Plans, Iowa Manure Applicator Certification, Construction permits, NPDES permits, etc.) Consult Iowa DNR or other consultants for advice.

SF 432 – bedded confinement manure stockpiling and liquid manure application on frozen or snow covered ground