

Manure Production Estimates

Dairy farmers in several provinces are faced with new regulations dealing with manure management and other aspects of environmental stewardship. To comply with the new rules, manure production volumes and nutrient concentrations need to be estimated. Producers who have attempted these calculations have found that the basic inputs required are unavailable or inappropriate.

How much manure does a lactating cow produce? What is the phosphorus content of manure from dry cows? In an attempt to provide more accurate answers to these questions, the American Society of Agricultural Engineers (ASAE) is about to release a number of new equations that can be used to estimate manure production volumes and nutrient excretion rates. The tables on this page have been calculated using the proposed equations, based on the most readily available input values. For the complete set of equations along with suggestions for their appropriate use, contact the WDD editor: steve@agromedia.ca.

Lactating cows

Several equations are proposed by the ASAE for calculating manure (feces plus urine) and nutrient excretion by lactating cows. Some are quite complex, requiring input estimates of body weight, dietary nutrient levels, dry matter intake and milk fat and protein tests. The values in Table 1 are calculated using equations where the only input variable required is daily milk yield.

For example, the equation used to calculate total wet manure excretion is:

$$(\text{Milk Yield, kg/day} \times 0.647) + 43.212$$

Dry cows

Calculation of excretion rates for dry cows is more complex, requiring a number of inputs. Total wet and dry matter calculations require estimates of body weight only. Nutrient excretion rates require knowledge of feed intake and dietary nutrient concentrations. The footnotes in Table 2 indicate the inputs required for each calculation.

Table 1. Manure (including urine) and nutrient excretion of lactating cows^a.

Milk Yield, kg/day	20	30	40	50	60
Total Wet Manure Excretion, kg/day	56	63	69	76	82
Manure DM Excretion, kg/day	7.0	8.0	8.9	9.9	10.8
Total Nitrogen Excretion, g/day	367	409	451	494	536
Total Phosphorus Excretion, g/day	61.5	69.2	76.9	84.7	92.4
Total Potassium Excretion, g/day	67	85	103	121	139

^aequations used are based only on milk yield

Table 2. Manure (including urine) and nutrient excretion of dry cows.

Dry Matter Intake, % of BW	1.4	1.6	1.8	2.0
Total Manure Excretion, kg/day ^a	36.1	36.1	36.1	36.1
Manure DM Excretion, kg/day ^a	4.5	4.5	4.5	4.5
Total Nitrogen Excretion, g/day ^{bc}	191	208	224	241
Total Phosphorus Excretion, g/day ^{bde}	17.4	20.6	23.7	26.8
Total Potassium Excretion, g/day ^{bf}	59.2	67.6	76.1	84.5

calculated using equation based on: ^abody weight (BW) of 650 kg; ^bvariable dry matter intakes; ^cdietary crude protein level of 12%; ^ddietary phosphorus level of 0.24%; ^edry period length of 60 days; ^fdietary potassium level of 0.65%

Table 3. Manure (including urine) and nutrient excretion of heifers.

Body Weight, kg	200	300	400	500	600
Dry Matter Intake, kg/day	4.7	6.7	8.9	11.6	15.1
Total Manure Excretion, kg/day ^{ab}	18.0	22.8	28.7	36.3	46.7
Manure DM Excretion, kg/day ^f	3.1	3.9	4.9	6.2	7.9
Total Nitrogen Excretion, g/day ^{bc}	95	114	135	161	193
Total Phosphorus Excretion, g/day ^{bd}	14.0	20.0	26.8	34.9	45.2
Total Potassium Excretion, g/day ^{be}	30.4	43.3	58.0	75.6	97.8

calculated using equation based on: ^avariable body weights; ^bvariable dry matter intakes; ^cdietary crude protein level of 12%; ^ddietary phosphorus level of 0.27%; ^edietary potassium level of 0.65%; ^fcalculated from Total Manure Excretion assuming 83% moisture level in heifer manure

Heifers

Table 3 presents example excretion rates for heifers. Like the equations used for dry cows, the equations proposed by the ASAE for heifers require multiple inputs, as described in the footnotes. There is no equation suggested to explicitly calculate daily manure dry matter excretion for heifers so these were calculated from total wet manure excretion using the ASAE-suggested value of 83% moisture in heifer manure.

Calves

When compiling the new equations, the ASAE found that there was not enough research data on manure excretion rates in calves to develop reliable equations. Based on a single nitrogen balance trial, a milk-fed calf might be expected to excrete about 17 grams of nitrogen per day. Another trial estimated that a 150 kg dairy calf would excrete 18.6 kg per day of wet manure containing 3.2 kg of manure dry matter and 139 grams of nitrogen.

source: ASAE Standard D384.1; <http://www.asae.org>

Manure Handling Calculations

- total weight of manure + organic bedding
= manure weight + bedding weight
- total volume of manure + organic bedding
= manure volume + $\frac{1}{2}$ of bedding volume
- raw manure density (no added bedding)
= 62 pounds/cubic foot = 993 kg/cubic meter
= 10 pounds/imperial gallon
- organic bedding density in kg/cubic meter:

loose straw	32 - 46
chopped straw	91 - 128
shavings	144
sawdust	192
- density of manure + organic bedding mix
= $\frac{(\text{manure} + \text{bedding total weight})}{(\text{manure wt/density}) + (\text{bedding wt/density}/2)}$
- typical weight ratio of feces to urine in raw dairy manure = 2.25 to 1
- typical moisture content of raw dairy manure:

lactating cows	87%
calves and heifers	83%
- 4.35 tonnes of liquid or slurry manure per 1,000 imperial gallons of spreader capacity