

Adjusting C:N Ratio in Horse Manure Composting

Fact Sheet

Equine Facilities Assistance Program

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Horse manure alone will have close to the optimum proportions of carbon and nitrogen that compost microbes require. Carbon is the major component of organic matter (45 to 55 percent) in manure and bedding. A long established “rule of thumb” suggests that a starting carbon-to-nitrogen ratio (C:N ratio) of 30 to 35 to 1 is optimal for composting. Horse manure may range from 30:1 to 50:1, but with the addition of bedding, particularly that derived from wood, C:N ratios will increase as the bedding contains much higher amounts of carbon. Given this reality, manure, hay, and bedding must be relatively fresh for optimal composting so that the microbe-available carbon and nitrogen is high. Alternatively, when bedding such as sawdust, rice hulls, or shavings is used in high proportions, additional nitrogen might need to be added to enhance the decomposition of the woody material. This additional nitrogen might be supplied with fresh grass clippings, hay, or fertilizer.

Remember, too much woody bedding will result in a lower quality compost product with a high C:N ratio that is less desirable for uses where the compost is tilled into soil. Adding nitrogen to reduce the initial starting C:N ratio is more cost-effective than adding special microbe inoculants that are on the market. The following table provides a range of C:N ratios for various materials.

| MATERIAL | C:N RATIO |
|-------------------|---------------|
| Wood Chips | 300 to 500: 1 |
| Oat Straw | 70-75:1 |
| Other Straw | 40 to 100:1 |
| Pure Horse Manure | 25 to 35:1 |
| Coffee Grounds | Approx. 20:1 |
| Leaves | 40 to 80:1 |
| Grass clippings | 10 to 20:1 |

Fertilizers that can be used to add nitrogen:

Ammonium Nitrate. Contains 34% N

Its advantages include approximately half of N in ammonia form for easy uptake, less impact on pH, and lower ammonia volatility. Disadvantages include higher cost and nitrate is less preferable than ammonium

Ammonium sulfate. Contains 21% N

Advantages include a good N analysis, ammonium is more stable than that in urea, it has good uptake, and is inexpensive. It also adds sulfur to the compost. Its disadvantages are it is acidic and reduces pH and requires higher amounts or pounds per pile.

Urea. Contains 46% N.

The advantage of urea is that it has a high analysis with a rapid conversion to ammonia and good uptake by compost microbes. Its disadvantage is the high ammonia volatility and temporary raise in pH.

To adjust compost with urea, uniformly add urea to the opened pile or windrow. The urea can be dissolved in water or added dry, then mixed in with the compost.

EXERCISE USING UREA:

Assume that 1 yard of manure and bedding equals 400 lbs, that wood chips in bedding is 40% by weight or it equals 160 lbs/yd, and that manure and bedding is 50% carbon.

Thus the bedding has a C:N ratio of 160. Calculated as follows: $160 \text{ lbs}/400 \text{ lbs} \times 400$ (a mid range taken from the table for wood chips) = 160

The remaining 240 lbs of manure would then have a C:N = 18. Calculated: $240/400 \times 30$ (mid range taken from the table for pure horse manure) = 18

Therefore, one cubic yard of manure and bedding would have a C:N of $160 + 18 = 178$ C:N

Now, a 50 lb bag of urea has $50 \text{ lbs} \times 46\% = 23 \text{ lbs N}$ per bag. Remembering that a yard of manure and bedding is 50% carbon, we have $400 \text{ lbs}/\text{yd} = 200 \text{ lbs}$ of carbon per yard. If the C:N = 178, then each yard of material contains $200/178 = 1.1 \text{ lbs}$ of N per yard. Furthermore, if optimal C:N ratio composting starts at 35:1, then $178/X = 35/1$ or $X = 5.1 \text{ lbs}$ of N and this is the amount of N that must be present for a 35:1 starting ratio.

ANSWER: Therefore, $5.1 \text{ lbs N} - 1.1 \text{ lbs of N} = 4$ additional lbs of N must be added per yard of manure and bedding, **OR**

4 lbs of N per yard that weighs 400 lbs is equivalent to 20 lbs of N per ton ($400 \text{ lbs} = 1/5 \text{ ton}$).
OR

Approximately 9 lbs (8.7 lbs) of urea must be added per yard of manure and bedding or 43.5 lbs of urea added per ton of manure and bedding. Remember urea is 46% N or $100/46 = 2.17$ X $4 \text{ lbs} = 8.7 \text{ lbs}$ or $8.7 \times 5 = 43.5 \text{ lbs}$ urea per ton. Therefore, you would add approximately one bag of urea for every ton or 5 yards of starting compost (manure plus bedding).

Contact your local Resource Conservation District for further information on manure management.

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