**Calculating Forage Yields on Vermont Farms**

Yield measurements are extremely important in nutrient management planning. Knowing average yields will allow producers to better match nutrient applications of manure and fertilizer to minimize costs, maximize fertilizer efficiency and reduce potential environmental problems. Yields are also critical as a measuring tool to evaluate new products, improve management techniques and allow producers to make more informed decisions concerning feeding practices for their livestock. Knowing you forage supplies for the year in the fall would allow producers to buy or sell forage at the time of the year that would be most financially rewarding to their operation.

Various methods of measuring yields are available to producers. The most accurate would be to weigh truck or wagon loads going into a silo or barn and taking dry matter samples. This is often not feasible to producers due to time and limitations of necessary equipment (scales). Other methods of yield checks include field sampling and documenting estimated weights of loads.

**Field Sampling for Yield**

As with soil sampling, testing forage yields must be done in a manner that will give you a representative sample of the whole field or fields. It is also important to consider the dry matter of the sample as moisture contents can vary greatly depending on when and how forages are harvested. It is always best to compare yields on a dry matter basis.

**Calculating Dry Matter** - To calculate dry matter, you can use various methods, including a microwave oven, or a Koster Moisture tester. In each instance, you need to measure the weights of the sample before and after drying to determine the amount of water driven off by drying. Almost all dried hay products are in the 10-15% moisture range or 85-90% dry matter. For more detailed information call your local Extension office and request NRAES publication 59 “Forage Moisture Determination”.

<table>
<thead>
<tr>
<th>Calculation</th>
<th>Explanation</th>
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<tbody>
<tr>
<td>Before drying-- 85 ounces</td>
<td>After drying -- 25 ounces</td>
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<tr>
<td>25/85 = 29.4% dry matter</td>
<td>(As is yield) x % dry matter = dry matter yield</td>
</tr>
<tr>
<td>If you harvested 23 tons of corn silage at 29.4% dry matter</td>
<td>23 x 29.4% = 6.76 tons of dry matter per acre</td>
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**Measuring cornfields and other row crops** - To take representative samples from cornfields, it is often easiest to determine what 1/1000 of an acre would be in the field. Yields from that size plot could then be cut, harvested and weighed to estimate the yield per acre. For most corn grown in Vermont, the following row widths and lengths would

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1 Adapted from “Calculating Forage Yields on Maine Farms” by Rick Kersbergen/ Extension Educator, University of Maine with some additions by Sid Bosworth, Extension Agronomist, UVM
correspond to 1/1000th of an acre. Counting the number of plants in this length of row and multiply by 1000 will also give you an estimate of the population of plants in the field per acre.

**Row width** | **Measure, cut count and weigh…**
---|---
30” (2.50 ft) | 17’5” (17.42 ft)
32” (2.67 ft) | 16’4.5” (16.32 ft)
34” (2.83 ft) | 15’4.75” (15.39 ft)
36” (3.00 ft) | 14’6” (14.50 ft)

The raw weight from 1/1000 of an acre divided by 2 will give you the estimated yield in tons per acre. Once you determine the dry matter of the sample, you can then multiply the yield by the % dry matter to get an estimate of dry matter yield per acre.

**Example:**
17’5” of a 30” corn row weighs 53 pounds
Divided by 2 = 26.5 tons per acre yield
26.5 tons/acre X 33% (dry matter of sample)=8.75 ton dry matter per acre

Note:
If your sample was wetter (23% dry matter) and your weight of yield was the same (26.5 tons) your dry matter yield would be quite a bit less
26.5 tons/acre X 23% (dry matter of sample) =6.1 ton dry matter yield per acre

*Measuring hay and drilled fields* - For checking yields of haycrop fields, a similar procedure except since there are no defined rows, you would simply harvest a known plot size and calculate that to a percentage of an acre. **There are 43,560 ft² in one acre.**

**Example:**
2’ by 2’ area = 4 ft²
43,560 ft² / 4 ft² = 10,890 units in an acre
If your sample weighed 1.8 pounds
1.8 lbs. x 10,890 = 19,602 pounds or 9.8 tons of grass per acre
If the grass was 25% dry matter (75% water)
9.8 tons (as is) x 25% = 2.5 tons of dry matter yield per acre.

Another method involves weighing a section of the mowed windrow and calculating the percentage of an acre that you weighed.

**Example:**
Mower cuts a windrow 14 ft. wide. If you pick up and weigh 10 ft of the windrow, you have .003214 of an acre (14 X 10 divided by 43,560)
If you harvested 55 lbs
55/.003214 = 17,113 lbs or about 8.6 tons of yield
If the grass was 25% dry matter (75% water):
8.6 tons (as is) x 25%dm = 2.2 tons dry matter yield per acre

Both of these methods are subject to extreme variation within the field so it would be important to take at least six to eight plots randomly chosen out of each field.
Measuring Wagon Loads - Measuring yields by wagonloads is probably the most common method used by producers. Ideally producers should weigh average loads to get a representative “load weight”. Again, it is important to know the dry matter of the forage to get an accurate measure of actual nutrient harvest.

Some recent work in Wisconsin at the Marshfield Ag. Research Station found that wagon loads in the 30-50% dry matter range averaged around 5 lbs. of dry matter per cubic foot of wagon. Surprisingly, the forage density did not vary greatly with forage type (corn silage or haylage).

Working with this information, we can now estimate the load on a wagon by multiplying volume times density.

**Example:**

A wagon measures 16 ft long by 7.25 feet wide and filled to a depth of 6 feet.

\[
16 \text{ ft} \times 7.25 \text{ ft} \times 6 \text{ ft} = 696 \text{ ft}^3
\]

\[
696 \text{ ft}^3 \times 5 \text{ lbs. dry matter per ft}^3 = 3,480 \text{ lbs. dry matter or 1.74 tons of dry matter yield per acre}
\]

If we wanted to calculate actual weight, we need to divide this figure by the dry matter of the forage.

Forage is 28 % dry matter

\[
1.74 \text{ tons divided by 28\%} = 6.96 \text{ tons of feed on the wagon.}
\]

Clearly, weighing all loads would provide a more accurate figure but this is often not feasible.

Measuring stored forage - Another method of estimating yields is to determine the total amount of stored forage and divide that by the number of acres to produce it. This will give an average yield across all fields that support that particular crop. This is a good method for "checking" field sampling or wagon load counting methods and works best with corn silage since it is only harvested once per year and the yield check can be made soon after harvest. Multi-cut forages are much more difficult to determine with this approach since silo fill and removal often occurs throughout the season.

For bunk silos, you will need to know silo volume (cubic feet) and silage density (lbs. of dry matter per cubic feet). Silage density depends on the type of forage, length of chop and degree of packing. A well packed bunk silo will have densities ranging from 12 to 17 lbs. d.m. per cubic foot.
Example,

A bunk silo measures 200' long by 30' wide and 10' high. It is filled to capacity with corn silage and is packed real well. Assuming a density of 16 pounds dry matter per ft$^3$,

\[
200' \times 30' \times 10' = 60,000 \text{ ft}^3 \times 16 \text{ lbs./ft}^3 = 960,000 \text{ lbs. dry matter}
\]

\[
960,000 \text{ lbs.} \div 2000 = 480 \text{ tons dry matter}
\]

\[
480 \text{ tons} \div 0.35 = 1371 \text{ tons of 65% moisture silage}
\]

If corn was grown on 80 acres, then

\[
1371 \text{ tons} \div 80 \text{ acres} = 17.1 \text{ tons per acre}
\]

For upright silos, you can obtain estimates of dry matter capacity from the following chart.

<table>
<thead>
<tr>
<th>Depth of settled silage (ft)</th>
<th>Inside diameter of silo (ft)</th>
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<tbody>
<tr>
<td>10</td>
<td>1</td>
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<td>12</td>
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<td>50</td>
<td>20</td>
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Source: Adapted from Silo Dry Matter Capacity Tables by the National Silo Association.