**Manure Management Plan**

**Nutrient Balance Sheet**

**Word Version User Guide**

**&**

**Sample Nutrient Balance Sheet**

**April 2025**

**Pennsylvania Nutrient Management Program**

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**Introduction**

This Nutrient Balance Sheet (NBS) can be used to plan application rates as part of a Manure Management Plan. The current version of the Manure Management Plan NBS can be downloaded from the Pennsylvania Nutrient Management Program website (<https://extension.psu.edu/programs/nutrient-management>). The Manure Management Plan NBS is available in two software formats: Microsoft Excel and Microsoft Word. This guide provides direction on how to complete Nutrient Balance Sheets using the Microsoft Word format.

**Supporting References & Resources**

This guide is intended to be primarily a “How-To” document rather than a comprehensive summary of the regulations, policy and guidance related to land application of manure in Pennsylvania. Guidance and resources for developing Manure Management Plans (MMP) are available through the Pennsylvania Clean Water Academy course: <https://pacleanwateracademy.remote-learner.net/course/view.php?id=1308>

This course includes links to:

* Land Application of Manure, A Supplement to Manure Management for Environmental Protection (Manure Management Plan Guidance)
* Manure Management Plan Workbook and Instructions
* Manure Management Short Form and Instructions
* Spreadsheets for Calculating Animal Equivalent Units and Manure Production
* Excel spreadsheet version of MMP NBS.

**Manure Plan Basis Options**

The Nutrient Balance Sheet format provides two options for a farmer to follow to determine appropriate manure and fertilizer application rates. Both options require that nitrogen (N) is not applied above the amount that the crop will take up the given year, with phosphorus (P) addressed by implementing one of the following options:

* **Option 1 – P Removal** – Application rates based on phosphorus removal of the planned crop with manure application setback requirements from environmentally sensitive areas (page 3). This option should be selected if there is no soil test for a field or the soil test phosphorus is 200 ppm or higher (Mehlich-3 test).
* **Option 2 – N Requirement** – Application rates based on the annual nitrogen requirements of the planned crop with manure application setback requirements from environmentally sensitive areas (page 3). This option is only available for fields that have soil test levels less than 200 ppm phosphorus by Mehlich-3 test.
* A third option, called the Phosphorus Index is possible to use, but must be completed by a certified Nutrient Management Plan Writer or Manure Broker using other planning tools.

Usually phosphorus-based rates (Option 1) are more restrictive (lower rates) than nitrogen-based rates (Option 2). However, selecting Option 1 will require the least time and cost to develop the NBSs if current soil tests are not available.

**Manure Application Setbacks**

Manure applied on the operation must follow the manure application setbacks required by the Pennsylvania Manure Management Manual. All three options require the following setbacks or restrictions from environmentally sensitive areas:

* Streams, lakes, springs and ponds- 100 feet. This setback can be reduced to 50 feet if the current soil test is less than 200 ppm P, no-till practices are used, and cover crops are planted when residue is removed. Alternatively, the setback can be reduced to 35 feet with a permanent vegetative buffer.
* Sinkholes (Existing Open) – 100 feet.
* Private Drinking Water Source (Well, Spring) – 100 feet.
* Public Drinking Water Source – 100 feet or greater if required by the source regulations.
* Swales, gullies or ditches- Manure cannot be applied within the channel of a non-vegetated concentrated water flow area.

A complete description of all applicable manure applications setbacks is provided in the instructions for the Environmentally Sensitive Areas Worksheet (page 18) of the Department of Environmental Protection’s Manure Management Manual:

<https://www.pa.gov/agencies/dep/programs-and-services/water/bwrnsm/nonpoint-source/agriculture-compliance/manure-management.html>

**Completing Nutrient Balance Worksheets**

A separate Nutrient Balance Worksheet (page 4) is needed for each crop group where manure may be applied at some time during the operation’s crop rotation. The worksheet documents the crop group nutrient requirements, appropriate nutrient (manure and fertilizer) application rates, manure application timing and procedures, and the fields that could receive that manure over the course of the crop rotation. This guide will provide step-by-step explanation of how to complete the worksheet followed by some completed examples.

**Manure Management Plan Nutrient Balance Worksheet**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Crop Group** | | | | | **Yield** | | **CMU/Field Identification**  (Each field must be clearly identified on a map) | | | | | **Acres** |
|  | | | | |  | |  | | | | |  |
| **Manure Plan Basis**  (check planning option) | **OPTION 1: P Removal** | | |  | **OPTION 2: N Requirement** | | | | | | |  |
| • Soil test not required. • Complete N and P2O5 columns;  K2O column is optional. • Use the P2O5 column to determine application rate (Row K phosphorus column). | | | | • MUST have Soil test < 200 ppm Mehlich 3 P. List soil test values below. • Complete N column; P2O5 and K2O columns are optional. • Use the N column to determine application rate (Row K nitrogen column). | | | | | | | |
| **Soil Test P (ppm)**  **(**Mehlich 3) | | |  | | | | |
| **Manure Group** | | | **Manure Type**  **(Poultry, Swine, Other, Compost)** | | | **Application Season** | | | | **Application Management** | | |
|  | | |  | | |  | | | |  | | |
| **Manure Analysis**  **Units** (Circle)  **NH4-N Organic N P2O5**  **K2O** . | | | | | | | | | | | **Manure % Solids** | |
| **lb/ton or lb/1000 gal** | |  | |  | |  | | |  | |  | |
| **Notes** |  | | | | | | | | | | | |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **N** | | **P2O5** | **K2O** | **Recommendation Basis** | |
| **A) Recommendation or Removal** (lb/A)  N – Soil Test or Tables 1 & 2 (AG Table 1.2-3;1.2-5)  P2O5 & K2O – Soil Test or Table 3 (AG Table 1.2-6) |  | |  |  |  | Soil Tests |
|  | Crop Removal |
| **B) Fertilizer Applied** (lb/A)  (Regardless of Manure e.g. Starter) |  | |  |  | **Application Record & Notes**  Record when the planned manure and fertilizer rates were applied or note changes. | |
| **C) Other Organic Sources Applied** (lb/A)  (e.g. Biosolids, Other Manure) |  | |  |  |
| **D) Residual Manure N** (lb/A)  Table 4 (AG Table 1.2-11) |  | |  |  |  | |
| **E) Previous Legume N** (lb/A)  Table 5 (AG Table 1.2-4) or Soil Test Report |  | |  |  |
| **F) Net Nutrient Requirement** (lb/A)  (A – B – C – D – E) |  | |  |  |
| **G) Manure Analysis**  (lb/ton or lb/1000gal) | NH4-N | Org N |  |  |
| H) Nitrogen Availability Factors  Table 6 (AG Table 1.2-12) | NH4-N | Org N |  |  |
| I) Available Nitrogen Fractions  (lb/ton or lb/1000gal) (G x H) | NH4-N | Org N |  |  |
| **J) Total Available Nitrogen**  (sum of Available N Fractions from row I) | NH4-N + Org N | |  |  |
| **K) Balanced Manure Rate-** (tons/A or gallons/A)  Solid manure- For N: (F ÷ J); For P: (F ÷ G)  Liquid manure- For N: (F ÷ J) x 1000; For P: (F ÷ G) x 1000 |  | |  |  |
| **L) Planned Manure Rate** (tons/A or gallons/A)  Must be less than or equal to Row K Balanced Rate and based on the plan basis being used |  | | | |
| **M) Nutrients Applied at Planned Rate** (lb/A)  Solid manure- For N: (L x J); For P & K: (L x G)  Liquid manure- For N: (L x J) ÷ 1000; For P: (L x G) ÷ 1000 |  | |  |  | **Note:** Nutrient balances for P2O5 and K2O based on crop removal (Row A) should not be used to determine additional fertilizer needs. Only recommendations based on soil tests should be used for this purpose. | |
| **N) Nutrient Balance at Planned Rate**  (lb/A) (F - M) (Indicate short or excess) |  | |  |  |

**Completing the Worksheet Information Section**

The number of individual worksheets required to address the applied manure is determined by the number of possible management scenarios on the operation. A separate worksheet must be completed for each crop group where manure may be applied. In some cases, more than one worksheet will be needed to plan for all possible management options of a crop group. Examples of completed worksheets are in the Appendix.

**Crop Group**

The first step in identifying crop groups is to identify the crops on the farm that will receive manure. Multiple fields can be included in the same crop group if the fields are managed the same. The next step requires determining different combinations of planning and management associated with each of those crops that will cause differences in recommendations, net nutrients required, and available nitrogen. Those differences will result in different balanced or maximum manure application rates for the same crop, therefore requiring the completion of separate worksheets. The primary planning and management considerations in crop group determination are:

* NBS Planning Basis (P Removal or N Based)
* Crop Yields
* Crop Rotation (e.g., corn after legume vs. corn after non-legume)
* Crop Harvest (e.g., corn silage vs. corn grain)
* Manure Application Seasons (spring or summer; early fall; late fall or winter)
* Manure Incorporation Timing (incorporated and how soon after application vs. not incorporated)

These worksheets are not tied to a particular crop year and are valid as long as there are not changes to the manure group or crop management.

**Yield**

Record the realistic expected crop yields for the crop group.

**CMU/Field Identification**

List each field on the farm that will, over the course of the crop rotation, have this crop group and potentially receive this manure group.

**Acres**

Record the total combined acreage of all the fields listed in the CMU/Field Identification box.

**Manure Plan Basis**

Check the manure planning base option that will be used to determine manure application rates. For Option 2, list the soil test Mehlich 3 ppm P values for the fields listed on the worksheet. If there are too many fields to list in the space provided on the worksheet, a separate summary sheet may be attached to the NBS. Another acceptable option would be to provide the range of soil test values with a statement such as: “The ppm P values for the noted 37 fields range from 53 to 84.”

**Manure Group**

The manure group name should include information, such as manure type, storage, and season of application, which clearly distinguishes it from other manure groups that may be on the farm.

**Manure Analysis**

Record the manure analysis results on the manure report. Nitrogen analysis must provide ammonium N (NH4-N) and organic N. If a manure analysis report is not available, book values from the Penn State Agronomy Guide may be used (Table 7).

**Application Season and Crop Utilization Period**

Record the season when the manure will be land applied. The season identification will be used with Table 6 to determine the nitrogen availability factor. Table 6 includes the following season options: spring, summer, early fall, late fall, winter, and grazing.

Winter manure application should be avoided if at all possible. Fields receiving winter applications must have at least 25% crop residue or an established cover crop at the time of application. Manure cannot be applied in winter to field with a slope greater than 15%. Winter manure application is acceptable on A, B, or C slopes.

The definition of winter is not exclusively a calendar consideration. Winter is defined as a time when any one of the following conditions exists:

1. the date is on or between December 15 and February 28, or
2. the ground is frozen at least 4 inches, or
3. the ground is snow covered.

**Application Method**

If the manure will not be incorporated within 7 days after application, use the following notation: “No Incorporation”. If the manure will be incorporated before 7 days, use a notation similar to the following: “Incorporated 2-4 Days”.

**Completing the Worksheet Manure Application Rate Section**

**Nutrient Columns & Recommendation Basis**

Before beginning to complete the Manure Application Rate section, determine which of the three nutrient columns (N, P2O5, K2O) will be completed. The N column must be completed on all worksheets. The P2O5 column is optional for N based rates and the K2O column is optional for both N and P based rates. A key consideration in this determination is whether the recommendation basis will provide useable additional fertilizer needs from Row N – Nutrient Balance After Manure.

**Row A – Recommendation or Removal**

Option 1 will use crop removal values from Tables 1, 2 or 3. Option 2 should use the recommendations from the required soil test reports instead of the nutrient removal tables. If soil test recommendations will be used as the basis of determining the manure rate, the nutrient balance numbers (Row N) are valuable to determine supplemental fertilizer needs. However, if crop removal values are used as the starting point, the nutrient balance numbers for P2O5 and K2O in Row N are not a reliable indicator of additional fertilizer needs.

**Row B – Fertilizer Applied**

The fertilizer nutrients listed here are from fertilizer, such as starter or herbicide carrier that will be applied regardless of the amount of manure nutrients applied.

**Row C – Other Organic Sources Applied**

In this row list the amount of nutrients from other sources such as applications of biosolids, mortality compost, food processing residuals, etc. When other sources of nutrients are applied, list the type of material and the application rate in Row C. Row C can be used for the second crop in a double crop as shown in the example in the Appendix.

**Row D – Residual Manure N**

This is an estimate of how much nitrogen will be available to the crop from previous manure applications. Use Table 4 to determine this value in the N column.

**Row E – Previous Legume N**

This is an estimate of how much nitrogen will be available to the crop following a previous legume crop. Use Table 5 to determine this value in the N column.

**Row F – Net Nutrient Requirement**

To obtain these values subtract the nutrient amounts from rows B, C, D and E from the recommendations in Row A.

**Row G – Manure Nutrient Content**

Transfer the appropriate values from the manure analysis values listed in the upper section of the worksheet.

**Row H – Nitrogen Availability Factor**

Only a portion of the total nitrogen is available to the crop in the year the manure is applied. Use Table 6 to select an N availability factor for both ammonium N (NH4-N) and organic N and place them in the appropriate column. The table considers five aspects to determine these factors: the season of application, crop utilization period, application management, the manure type used, and the manure group percent solids.

**Row I – Available Nitrogen Fractions**

Multiply the NH4-N content of the manure (Row G) by the NH4-N availability factor (Row H) to obtain the available ammonium fraction and list it in the NH4-N box in the I column. Multiply the organic N content of the manure (Row G) by the organic N availability factor (Row H) to obtain the available organic N fraction and list it in the Org N box in the I column.

**Row J – Total Available Nitrogen**

Add the Available N Fractions from Row I to attain the Total Available N and list it in the J column.

**Row K – Balanced Manure Rate**

The balanced rate is the maximum amount of this manure type that can be applied for the nutrient being considered. Use the appropriate column to determine this manure rate. For N requirement rates use the N column. For P removal rates use the P2O5 column.

Solid Manure Calculations: Since solid manure rates are applied in tons and nutrient analysis is provided in lbs of nutrient/ton the math is fairly straight forward. For nitrogen divide the Net N Requirement (Row F) by the Total Available Nitrogen (Row J) and place in the Balanced Manure Rate (Row K). For P2O5 divide the net P2O5 requirement (Row F) by the P2O5 content of the manure (Row G) and place in P2O5 (Row K).

Liquid Manure Calculations: The math for calculating balanced manure rates can be tricky for liquid manure. Since manure analysis units are in lbs/1000 gallons, there is an additional step of multiplying by 1000. For the nitrogen balanced manure rate in Row K, divide Row F by Row J and then multiply by 1000. For the phosphorus balanced manure rate in Row K, divide Row F by Row G and then multiply by 1000.

**Example:** If the Net N Requirement (Row F) was 125 lbs N/acre and the Total Available N (Row J) was 25 lbs N/1000 gallons, the nitrogen balanced manure calculation would be:

**Row L – Planned Manure Rate**

This is the actual planned manure rate. The planned rate cannot exceed the balanced rate in Row K. It should be based on the application equipment capabilities determined by calibration. In addition, the amount of manure applied during one pass cannot exceed the following limits:

**For manure applied in Spring, Summer or Fall: Single applications of liquid or semisolid manure applications may not exceed rates of 9,000 gallons per acre**. If the planned manure rate exceeds 9,000 gallons per acre, the plan must designate separate applications each less than 9,000 gallons. This can be handled two ways in the manure management plan:

1. Plan the separate applications as multiple applications (see Example 6 in the Appendix) and allow for adequate drying time between the applications.
2. Entered the total combined rate in Row L. Make a note indicating the planned rates for separate applications during the same application season. Allow adequate drying time so there is no evidence of pooling between the separate applications.

**The maximum application rate for manure applied in winter (as defined on page 6) are:**

* 5,000 gallons per acre for liquid manure
* 20 tons per acre for dry non-poultry manure
* 3 tons per acre for dry poultry manure.

**Row M – Nutrients Applied at Planned Rate**

Solid manure calculations: For nitrogen multiply the Planned Manure Rate (Row L) by the Total Available Nitrogen (Row J). For P2O5 and K2O, multiply the planned rate (Row L) by the manure nutrient content (Row G).

Liquid Manure Calculations: Since manure analysis units are in lbs/1000 gallons, the calculation requires an extra step of dividing by 1000. For nitrogen, Row M is found by multiplying Row L by Row J and then dividing by 1000. For P2O5 and K2O, multiply the planned rate (Row L) by the manure nutrient content (Row G) and then divide by 1000.

**Example:** Continuing the example above for Row K, if the Planned Manure Rate (Row L) was 4000 gallons/acre and the Total Available N (Row J) was 25 lbs N/1000 gallons, the math for the actual amount of nutrients to be applied looks like this:

**Row N – Nutrient Balance at Planned Rate**

Subtract the nutrients applied at the planned rate (Row M) from the net nutrients required (Row F). If soil test recommendations were used in Row A, then positive values in Row N indicate that more fertilizer or other sources of nutrients are needed to meet crop production (yield) goals. If crop removal values were used in Row A, then positive numbers for P2O5 and K2O in Row N should not be used to determine additional fertilizer needs. (Only recommendations based on soil tests should be used for this purpose.) Negative numbers in Row N indicate that a nutrient will be applied in excess of crop need at the planned manure rate. Negative numbers are allowable for P2O5 (Option 2 only) and K2O (Options 1 and 2).

**Completing the Manure Management Plan Summary and Winter Application Worksheet**

Transfer the required information from each worksheet to the Manure Management Plan Summary Page in the Manure Management Plan Workbook. Fields with winter application planned should be listed in both the Manure Management Plan Summary page and the Winter Application Worksheet.

**Additional Information and Examples**

Following Tables 1-7 is an Appendix which includes several example worksheets. Examples include summer crops, winter crops, double crops, multiple manure applications and manure applied to a pasture. Both manure plan options (Option 1 and Option 2) are included in the example worksheets.

**Table 1. Nitrogen recommendations for agronomic crops.** (Table 1.2-3, Penn State Agronomy Guide)

These are base recommendations and should be adjusted for previous crop, previous manure history, and planned manure applications (see “Manure Nutrient Management” section).

|  |  |  |
| --- | --- | --- |
| **Crop** | **Recommendation (lb N/unit of expected yield)** | **Comments** |
| Corn grain (bu/A) | 1 | For better N efficiency, delay application of the nitrogen until the corn is between 10 and 20 inches tall. If the field has a history of manure and/or legumes, delay all of the N. If there is no history of manure and/or legumes, split the N, applying one-third near to planting and delaying the balance. Adjust this recommendation for any previous legume in the rotation (see Table 1.2-4) and for residual N from previous manure applications (see Tables 1.2‑11 and 1.2-12). The PSNT or chlorophyll meter test can be used to refine N recommendations for corn, especially where manure is a major nutrient source. |
| Corn silage (ton/A) | 7 | For better N efficiency, delay application of the nitrogen until the corn is between 10 and 20 inches tall. If the field has a history of manure and/or legumes, delay all of the N. If there is no history of manure and/or legumes, split the N, applying one-third near to planting and delaying the balance. Adjust this recommendation for any previous legume in the rotation (see Table 1.2-4) and for residual N from previous manure applications (see Tables 1.2‑11 and 1.2-12). The PSNT or chlorophyll meter test can be used to refine N recommendations for corn, especially where manure is a major nutrient source. |
| Grain sorghum (bu/A) | 0.75 | Adjust this recommendation for any previous legume in the rotation (see Table 1.2-4) and for residual N from previous manure applications (see Tables 1.2‑11 and 1.2-12). |
| Forage sorghum (ton/A) | 7 | Adjust this recommendation for any previous legume in the rotation (see Table 1.2-4) and for residual N from previous manure applications (see Tables 1.2‑11 and 1.2-12). |
| Oats (bu/A) | 0.8 | Apply the N with any other fertilizer before planting. Adjust this recommendation for any residual N from previous manure applications (see Tables 1.2‑11 and 1.2-12). |
| Wheat/rye (bu/A) | 1 | If plants did not tiller well, apply N by mid-March; otherwise, apply any time up to growth stage 5. Adjust this recommendation for any residual N from previous manure applications (see Tables 1.2‑11 and 1.2-12). |
| Barley (bu/A) | 0.8 | If plants did not tiller well, apply N by mid-March; otherwise, apply any time up to growth stage 5. Adjust this recommendation for any residual N from previous manure applications (see Tables 1.2‑11 and 1.2-12). |
| Small grain silage (ton/A) | 15 | Apply at greenup in the spring. |
| Grass hay (ton/A dry hay equivalent) | 50 | Split the nitrogen recommendation and apply it based on the expected yield for each cutting. For grass-legume mixtures, if the legume is more than 50% of the stand, the field should be managed as a legume; thus, no nitrogen is recommended. Adjust this recommendation for any residual N from previous manure applications (see Tables 1.2‑11 and 1.2-12). |

**Table 2. Nitrogen removal by legumes.** (Table 1.2-5, Penn State Agronomy Guide)

|  |  |  |
| --- | --- | --- |
| **Legume Crop** | **Pounds of Nitrogen Removed Per Unit of Yield** | **Comments** |
| Alfalfa  (ton/A) | 50 | No nitrogen application recommended. Although legumes will use N from manure and other sources, applying N may increase the competition from weeds and grasses. If you apply manure, limit it to an application rate that balances the crop’s phosphorus requirement. |
| Clover  (ton/A) | 40 | No nitrogen application recommended. Although legumes will use N from manure and other sources, applying N may increase the competition from weeds and grasses. If you apply manure, limit it to an application rate that balances the crop’s phosphorus requirement. |
| Trefoil  (ton/A) | 50 | No nitrogen application recommended. Although legumes will use N from manure and other sources, applying N may increase the competition from weeds and grasses. If you apply manure, limit it to an application rate that balances the crop’s phosphorus requirement. |
| Soybeans  (bu/A) | 3.2 | No nitrogen application recommended. Although legumes will use N from manure and other sources, applying N may increase the competition from weeds and grasses. If you apply manure, limit it to an application rate that balances the crop’s phosphorus requirement. |

**Table 3. Typical crop nutrient removal for phosphorus and potassium.** (Table 1.2-6, Penn State Agronomy Guide)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Crop (units)** | **Per Unit of Yield** | | **Typical Yield Per Acre** | **Removal for Given Yield** | |
| **P205** | **K20** | **P205** | **K20** |
| Corn (bu) | 0.4 | 0.3 | 150 (bu) | 60 | 45 |
| Corn silage (T)1 | 4.0 | 8.0 | 25 (T) | 100 | 200 |
| Grain sorghum (bu) | 0.6 | 0.8 | 125 (bu) | 75 | 100 |
| Forage sorghum (T)1 | 3.0 | 10.0 | 15 (T) | 45 | 150 |
| Sorghum/sudangrass1 | 7.0 | 7.0 | 15 (T) | 105 | 105 |
| Alfalfa (T)2,3 | 15.0 | 50.0 | 5 (T) | 75 | 250 |
| Red Clover (T)2,3 | 15.0 | 40.0 | 3.5 (T) | 52 | 140 |
| Trefoil (T)2,3 | 15.0 | 40.0 | 3.5 (T) | 52 | 140 |
| Cool-season grass (T)2,3 | 15.0 | 50.0 | 4 (T) | 60 | 200 |
| Bluegrass (T)2,3 | 10.0 | 30.0 | 2.5 (T) | 25 | 75 |
| Wheat/rye (bu)4 | 1.0 | 1.8 | 60 (bu) | 60 | 108 |
| Oats (bu)4 | 0.9 | 1.5 | 80 (bu) | 72 | 120 |
| Barley (bu)4 | 0.6 | 1.5 | 75 (bu) | 45 | 112 |
| Soybeans (bu) | 1.0 | 1.4 | 50 (bu) | 50 | 70 |
| Small grain silage (T)1 | 7.0 | 26.0 | 6 (T) | 42 | 156 |

1. 65 percent moisture.
2. For legume-grass mixtures, use the predominant species in the mixture.
3. Dry hay equivalent, 10 percent moisture.
4. Includes straw.

Table 4. Residual nitrogen available from past manure applications based on historical frequency of application. (Table 1.2-11, Penn State Agronomy Guide)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Historical Frequency of Manure Application on the Field | | | | |
| To use this table, determine the frequency of manure application and move to the right in the row to determine the amount of residual N that is available from past manure applications. Deduct this amount of residual N from the basic N recommendation before determining any additional fertilizer or manure application rates. | | | | |
|  | **Pounds N available to a summer crop (corn, grass hay, oats, etc.)** | **Pounds N available to a winter crop (wheat, barley, rye, etc.)** | Pounds N available to the winter crop in a double-crop system | Pounds N available to the summer crop in a double-crop system |
| **Rarely received manure in the past (<2 out of 5 years)**  NOTE:  If a field only received manure once out of 5 years, but this application was made the previous year, use the frequent credit for the following year. | 0 | 0 | 0 | 0 |
| Frequently received manure (2–3 out of 5 years) | 20 | 7 | 7 | 13 |
| Continuously received manure (4–5 out of 5 years) | 35 | 11 | 11 | 24 |

**Table 5. Residual nitrogen contributions from legumes to summer annual crops.** (Table 1.2-4 Penn State Agronomy Guide)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Previous Crop**1 | **Percent Stand** | **High-Productivity Fields**  **(Soil Productivity Group 1) 2** | **Moderate-Productivity Fields**  **(Soil Productivity Groups 2 & 3) 2** | **Low-Productivity Fields**  **(Soil Productivity Groups 4 & 5) 2** |
|  | **Nitrogen Credit (lb/A)** | | | |
| **First year after alfalfa** | >50 | 120 | 110 | 80 |
| 25–49 | 80 | 70 | 60 |
| <25 | 40 | 40 | 40 |
| **First year after clover or trefoil** | >50 | 90 | 80 | 60 |
| 25–49 | 60 | 60 | 50 |
| <25 | 40 | 40 | 40 |
| **First year after soybeans harvested for grain** | 1 lb nitrogen/bu soybeans | | | |

1. When a previous legume crop is checked on the Penn State soil test information sheet, the residual nitrogen for the year following the legume is calculated and given on the report. This credit should be deducted from the N recommendation given on the soil test report.

2. See Agronomy Guide Table 1.1-1 in the basic soils section for information on soil productivity groups.

**Table 6.** Factors for calculating manure nitrogen availability based on manure ammonium and organic nitrogen fractions. To determine available nitrogen in manure, multiply the appropriate NH4-N and organic N availability factor in the table below by the NH4-N and organic N content of the manure. The appropriate factor is determined based on the manure application season, crop utilization period, application method (time of application, use of cover crop, etc.) manure type and solids content. (Table 1.2-12, Penn State Agronomy Guide).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **Poultry** | **Poultry**  **<5% Solids2** | **Swine** | **Swine**  **<5% Solids2** | **Dairy, Beef and Other** | **Dairy, Beef,**  **and Other**  **<5% Solids2** | **Compost** |
| **Application Season and**  **Crop Utilization Period Application Method1** | | **NH4-N Org-N** | **NH4-N Org-N** | **NH4-N Org-N** | **NH4-N Org-N** | **NH4-N Org-N** | **NH4-N Org-N** | **NH4-N Org-N** |
| Late Spring or Summer Application3  For late spring and summer use by grass or legume hay, corn, and other summer crops. | Injected or incorporated 0.90 0.50  the same day | | 0.90 0.50 | 0.80 0.50 | 0.80 0.50 | 0.80 0.35 | 0.80 0.35 | 0.80 0.10 |
| Incorporated within 0.80 0.50  1 day | | 0.80 0.50 | 0.60 0.50 | 0.60 0.50 | 0.60 0.35 | 0.60 0.35 | 0.60 0.10 |
| Incorporated within 0.60 0.50  2-4 days | | 0.80 0.50 | 0.40 0.50 | 0.60 0.50 | 0.40 0.35 | 0.60 0.35 | 0.40 0.10 |
| Incorporated within  5-7 days 0.40 0.50 | | 0.60 0.50 | 0.20 0.50 | 0.40 0.50 | 0.20 0.35 | 0.40 0.35 | 0.20 0.10 |
| Incorporated after 0.20 0.50  7 days or none | | 0.40 0.50 | 0.10 0.50 | 0.30 0.50 | 0.10 0.35 | 0.30 0.35 | 0.10 0.10 |
| Early Fall Application3  For fall and early spring use by grass or legume hay, small grains, and small grain silage and other winter crops in a double-crop system. | Injected or incorporated 0.80 0.30  within 0-2 days | | 0.80 0.30 | 0.60 0.30 | 0.60 0.30 | 0.60 0.25 | 0.60 0.25 | 0.40 0.10 |
| Incorporated within 0.50 0.30  3-7 days | | 0.70 0.30 | 0.30 0.30 | 0.50 0.30 | 0.30 0.25 | 0.50 0.25 | 0.20 0.10 |
| Incorporated after 0.20 0.30  7 days or none | | 0.40 0.30 | 0.10 0.30 | 0.30 0.30 | 0.10 0.25 | 0.30 0.25 | 0.00 0.10 |
| Early Fall Application3  For following  summer crops | Injected or incorporated  within 0-2 days, with 0.45 0.50  unharvested cover crop | | 0.45 0.50 | 0.35 0.50 | 0.35 0.50 | 0.35 0.35 | 0.35 0.35 | 0.35 0.10 |
| Incorporated within 3-7  days, with unharvested 0.20 0.50  cover crop | | 0.40 0.50 | 0.15 0.50 | 0.35 0.50 | 0.15 0.35 | 0.35 0.35 | 0.15 0.10 |
| Incorporated after 7  days or none, with 0.00 0.50  unharvested cover crop | | 0.20 0.50 | 0.00 0.50 | 0.20 0.50 | 0.00 0.35 | 0.20 0.35 | 0.00 0.10 |
| No cover crop, all 0.00 0.50  incorporation timings | | 0.00 0.50 | 0.00 0.50 | 0.00 0.50 | 0.00 0.35 | 0.00 0.35 | 0.00 0.10 |

**Table 6.** Factors for calculating manure nitrogen availability based on manure ammonium and organic nitrogen fractions (continued).

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | **Poultry** | **Poultry**  **<5% Solids2** | **Swine** | **Swine**  **<5% Solids2** | **Dairy, Beef and Other** | **Dairy, Beef,**  **and Other**  **<5% Solids2** | **Compost** |
| **Application Season and**  **Crop Utilization Period Application Method1** | | | **NH4-N Org-N** | **NH4-N Org-N** | **NH4-N Org-N** | **NH4-N Org-N** | **NH4-N Org-N** | **NH4-N Org-N** | **NH4-N Org-N** |
| Late Fall/Winter/Early Spring Application4,5  For following spring and summer crops | Early spring use by grass  or legume hay, small 0.60 0.30  grains, small grain silage | | | 0.60 0.30 | 0.50 0.30 | 0.50 0.30 | 0.50 0.25 | 0.50 0.25 | 0.50 0.10 |
| Summer crop use with 0.00 0.50  no cover crop | | | 0.00 0.50 | 0.00 0.50 | 0.00 0.50 | 0.00 0.35 | 0.00 0.35 | 0.00 0.10 |
| Summer crop use after 0.60 0.50  unharvested cover crop | | | 0.60 0.50 | 0.50 0.50 | 0.50 0.50 | 0.50 0.35 | 0.50 0.35 | 0.50 0.10 |
| Early and Late Fall/ Winter/ Early Spring  For a following summer crop in a double crop system | | Additional organic N  available to the summer  crop in a double crop  system from manure 0.00 0.25  applied in the fall, winter,  or early spring for the  winter crop | | 0.00 0.25 | 0.00 0.25 | 0.00 0.25 | 0.00 0.20 | 0.00 0.20 | 0.00 0.10 |
| Grazing Manure deposited by  grazing with nutrient 0.15 0.15  For the crop that is uptake during growing  being grazed season | | | | 0.15 0.15 | 0.20 0.20 | 0.20 0.20 | 0.20 0.20 | 0.20 0.20 | n/a n/a |

1 If application type was incorporated, it was mechanical incorporation or incorporation by 0.5 inch of rain.

2 In some cases, adjustments to the ammonium availability factors have been implemented for very liquid manures (< 5 percent solids) to account for soaking in on application, which reduces volatilization.

3 Early fall, late spring and summer would be when it is warm enough for plant growth and microbial activity to be maintained (soil temperature >50°F at 2 inches deep).

4 Late fall, winter, and early spring is when it is so cold that there is limited plant growth or microbial activity (soil temperature <50°F at 2 inches deep).

5 Under Act 38, any one of the following conditions meets the "winter" definition: December 15 to February 28, Frozen ground (4 inch depth), Snow-covered ground.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Table 7: Typical average daily production and total content of manure in Pennsylvania.** (Table 1.2-10, Penn State Agronomy Guide) | | | | | | | | |
| **Animal Type** | | **Daily Production** | **Manure % Dry Matter** | **Analysis Units** | **NH4-N** | **Org. N** | **P2O5** | **K2O** | **Comments** |
|  | **Dairy cattle** | | | | | | | |  |
| Lactating cow, liquid | | 13 gal/AU/day | <10 | lb/1,000 gal | 14 | 14 | 13 | 25 | Production does not include dilution; analysis includes dilution to approximately 7.5% solids. |
| Dry cow, liquid | | 6 gal/AU/day | <10 | lb/1,000gal | 14 | 14 | 13 | 25 |
| Lactating cow, solid | | 111 lb/AU/day | 12 | lb/ton | 2 | 8 | 4 | 8 | No bedding included in production or analysis figures; use these analyses for estimating nutrients deposited on pastures by dairy cows, dairy dry cattle, and dairy young cattle. |
| Dry cow, solid | | 51 lb/AU/day |  | lb/ton | 0 | 9 | 3 | 7 |
| Heifer | | 60 lb/AU/day |  | lb/ton | 2 | 8 | 3 | 7 |
| Calf | | 80 lb/AU/day |  | lb/ton | 2 | 8 | 3 | 4 |
| Veal | | 7 gal/AU/day | 2 | lb/1,000 gal | 14 | 5 | 13 | 25 | Production does not include dilution; analysis includes dilution. |
|  | **Beef** | | | | | | | | |
| Cow, solid | | 90 lb/AU/day | 12 | lb/ton | 1 | 10 | 7 | 10 | No bedding or dilution included in production or analysis figures; use these analyses for estimating nutrients deposited on pastures by a beef cow and calf, beef calves, and steers. |
| Cow, liquid | | 11 gal/AU/day |  | lb/1,000 gal | 10 | 22 | 16 | 27 |
| Calf | | 106 lb/AU/day | 12 | lb/ton | 2 | 9 | 7 | 10 |
| Finishing cattle, solid | | 49 lb/AU/day | 8 | lb/ton | 1 | 13 | 5 | 8 |
| Finishing cattle, liquid | | 6 gal/AU/day |  | lb/1,000 gal | 19 | 43 | 19 | 39 |
|  | **Swine** | | | | | | | | |
| Farrow to wean (includes sows), liquid | | 11 gal/AU/day | 2.5 | lb/1,000 gal | 12 | 6 | 18 | 11 | Production includes a typical amount of in-barn dilution water but not rainfall for an outdoor storage, except for farrow to wean, which also includes rainfall; analysis includes dilution to approximately the percent dry matter indicated. |
| Nursery, liquid | | 14 gal/AU/day | 1.5 | lb/1,000 gal | 12 | 7 | 8 | 14 |
| Wean to finish, liquid | | 5.5 gal/AU/day | 4 | lb/1,000 gal | 24 | 13 | 23 | 21 |
| Grow-finish, liquid | | 7 gal/AU/day | 4 | lb/1,000 gal | 20 | 11 | 24 | 22 |
| Farrow to wean (includes sows), solid | | 47 lb/AU/day |  | lb/ton | 12 | 7 | 13 | 15 | No bedding included in production or analysis figures; use these analyses for estimating nutrients deposited on pastures by swine. |
| Nursery, solid | | 75 lb/AU/day |  | lb/ton | 13 | 7 | 7 | 13 |
| Wean to finish, solid | | 49 lb/AU/day |  | lb/ton | 15 | 8 | 8 | 11 |
| Grow-finish, solid | | 49 lb/AU/day |  | lb/ton | 15 | 8 | 8 | 11 |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  | | --- | --- | |  | **Table 7: Typical average daily production and total content of manure in Pennsylvania** (continued). | | | | | | | | | | |
| **Animal Type** | | **Daily Production** | **Manure % Dry Matter** | **Analysis Units** | **NH4-N** | **Org. N** | **P2O5** | **K2O** | **Comments** |
| **Sheep/Goats** | | 40 lb/AU/day | 25 | lb/ton | 1 | 22 | 8 | 20 | No bedding included in production or analysis figures; use these analyses for estimating nutrients deposited on pastures by sheep and goats. |
| **Horse** | | 55 lb/AU/day | 20 | lb/ton | 1 | 11 | 5 | 9 | No bedding included in production or analysis figures; use these analyses for estimating nutrients deposited on pastures by horses. |
|  | **Poultry** | | | | | | | | |
| Layer (364 days)1 | | 26.5 lb/AU/d | 65\* | lb/ton | 12 | 49 | 58\* | 33\* |  |
| Layer breeders (364 days) | | 24 lb/AU/d | 66 | lb/ton | 10 | 41 | 70 | 45 |
| Pullet (118 days) 1 | | 30 lb/AU/d | 63\* | lb/ton | 7 | 64 | 58 | 39\* |
| Broiler (38-46 days) 1 | | 28 lb/AU/d | 67 | lb/ton | 9 | 49 | 43 | 47\* | Production and analysis figures include litter. |
| Broiler breeders (364 days) 1 | | 20 lb/AU/d | 48 | lb/ton | 5 | 28 | 47 | 30 |  |
| Turkey tom (93-148 days) 1 | | 13 lb/AU/d | 61 | lb/ton | 11 | 42 | 52 | 46 |
| Turkey hen (130-133 days) 1 | | 13 lb/AU/d | 57 | lb/ton | 10 | 41 | 57 | 50 |
| Duck (dry) | | 110 lb/AU/day | 27 | lb/ton | 4 | 17 | 26 | 15 | No bedding included in production or analysis figures. |
| Duck (wet) | | 13 gal/AU/day | 5 | lb/1000 gal | 21 | 12 | 23 | 16 | Production does not include dilution; analysis includes dilution to approximately 5% solids. |

Note: When possible, have manure analyzed. Actual values may vary over 100 percent from averages in the table.

1. Typical production days.

\* Significant differences exist between management styles.

**Appendix**

**Common Management Scenarios:**

The following pages provide several example worksheets to calculate manure application rates for a field or group of fields with a single manure application to a summer crop. Explanations of the calculations are noted in the Additional Record & Notes section.

**Example 1:** **Corn after corn, Option 2**. Broiler litter applied in spring without incorporation to corn following a previous corn crop. In this example, the planned manure rate of 2 tons per acre applies more P2O5 and K2O than the soil test recommendations, leading to negative values in Row N (Nutrient Balance at Planned Rate). However, supplemental nitrogen (64 lbs/acre) will be needed to meet the yield goal of 150 bushels per acre.

**Example 2: Corn after soybeans, Option 2**. Broiler litter applied in spring without incorporation to corn following a previous soybean crop that yielded 50 bu/ac. Note that the soil test does not recommend any P2O5 or K2O for this field. After accounting for the starter fertilizer, nitrogen credits (residual manure N and previous legume N) and broiler litter applied (2 tons per acre) the nitrogen balance is 14 pounds per acre.

**Example 3: Corn after alfalfa, Option 2.** Swine liquid applied in spring without incorporation to corn following alfalfa (<25% stand). For liquid manure, check the manure analysis report for the % solids to make sure to use the correct nitrogen availability factors from Table 6.

**Example 4: Corn after alfalfa, Option 1.** Swine liquid applied in spring without incorporation to corn following alfalfa (<25% stand). This is the same as Example 3 except without a soil test, so the manure application rate is limited to the crop phosphorus removal rate. Since there is not a soil test, the P2O5 or K2O values in Row A are based on crop removal (Table 3). The P2O5 or K2O values in Row N should not be used to determine additional fertilizer needs for these nutrients because they are not based on soil test recommendations.

**Manure Management Plan Nutrient Balance Worksheet**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Crop Group** | | | | | **Yield** | | **CMU/Field Identification**  (Each field must be clearly identified on a map) | | | | | **Acres** |
| **Corn after Corn** | | | | | **150 bu/ac** | | **1 - 8** | | | | | **90** |
| **Manure Plan Basis**  (check planning option) | **OPTION 1: P Removal** | | |  | **OPTION 2: N Requirement** | | | | | | | **X** |
| • Soil test not required. • Complete N and P2O5 columns;  K2O column is optional. • Use the P2O5 column to determine application rate (Row K phosphorus column). | | | | • MUST have Soil test < 200 ppm Mehlich 3 P. List soil test values below. • Complete N column; P2O5 and K2O columns are optional. • Use the N column to determine application rate (Row K nitrogen column). | | | | | | | |
| **Soil Test P (ppm)**  **(**Mehlich 3) | | | **154** | | | | |
| **Manure Group** | | | **Manure Type**  **(Poultry, Swine, Other, Compost)** | | | **Application Season** | | | | **Application Management** | | |
| **Broiler** | | | **Poultry** | | | **Spring** | | | | **No incorporation** | | |
| **Manure Analysis**  **Units** (Circle)  **NH4-N Organic N P2O5**  **K2O** . | | | | | | | | | | | **Manure % Solids** | |
| **lb/ton or lb/1000 gal** | | **31.2** | | **23.1** | | **33.1** | | | **61.8** | | **71.7** | |
| **Notes** |  | | | | | | | | | | | |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **N** | | **P2O5** | **K2O** | **Recommendation Basis** | |
| **A) Recommendation or Removal** (lb/A)  N – Soil Test or Tables 1 & 2 (AG Table 1.2-3;1.2-5)  P2O5 & K2O – Soil Test or Table 3 (AG Table 1.2-6) | **150** | | **60** | **45** | x | Soil Tests |
|  | Crop Removal |
| **B) Fertilizer Applied** (lb/A)  (Regardless of Manure e.g. Starter) | **15** | | **30** | **30** | **Application Record & Notes**  Record when the planned manure and fertilizer rates were applied or note changes. | |
| **C) Other Organic Sources Applied** (lb/A)  (e.g. Biosolids, Other Manure) | **0** | | **0** | **0** |
| **D) Residual Manure N** (lb/A)  Table 4 (AG Table 1.2-11) | **35** | |  |  | Manure Residual N:  Summer crop with manure applied 4-5 of 5 yrs = 35 lbs. N.  N availability factors from Table 6: Poultry manure, spring applied with no incorporation.  Negative values in Row N indicate excess nutrients. | |
| **E) Previous Legume N** (lb/A)  Table 5 (AG Table 1.2-4) or Soil Test Report | **0** | |  |  |
| **F) Net Nutrient Requirement** (lb/A)  (A – B – C – D – E) | **100** | | **30** | **15** |
| **G) Manure Analysis**  (lb/ton or lb/1000gal) | NH4-N  **31.2** | Org N  **23.1** | **33.1** | **61.8** |
| H) Nitrogen Availability Factors  Table 6 (AG Table 1.2-12) | NH4-N  **0.2** | Org N  **0.5** |  |  |
| I) Available Nitrogen Fractions  (lb/ton or lb/1000gal) (G x H) | NH4-N  **6.24** | Org N  **11.55** |  |  |
| **J) Total Available Nitrogen**  (sum of Available N Fractions from row I) | NH4-N + Org N  **17.79** | |  |  |
| **K) Balanced Manure Rate-** (tons/A or gallons/A)  Solid manure- For N: (F ÷ J); For P: (F ÷ G)  Liquid manure- For N: (F ÷ J) x 1000; For P: (F ÷ G) x 1000 | **5.6** | | **--** |  |
| **L) Planned Manure Rate** (tons/A or gallons/A)  Must be less than or equal to Row K Balanced Rate and based on the plan basis being used | **2** | | | |
| **M) Nutrients Applied at Planned Rate** (lb/A)  Solid manure- For N: (L x J); For P & K: (L x G)  Liquid manure- For N: (L x J) ÷ 1000; For P & K: (L x G) ÷ 1000 | **36** | | **66** | **124** | **Note:** Nutrient balances for P2O5 and K2O based on crop removal (Row A) should not be used to determine additional fertilizer needs. Only recommendations based on soil tests should be used for this purpose. | |
| **N) Nutrient Balance at Planned Rate**  (lb/A) (F - M) (Indicate short or excess) | **64** | | **-36** | **-109** |

**Manure Management Plan Nutrient Balance Worksheet**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Crop Group** | | | | | **Yield** | | **CMU/Field Identification**  (Each field must be clearly identified on a map) | | | | | **Acres** |
| **Corn after Soybeans** | | | | | **150 bu/ac** | | **1 - 8** | | | | | **90** |
| **Manure Plan Basis**  (check planning option) | **OPTION 1: P Removal** | | |  | **OPTION 2: N Requirement** | | | | | | | **X** |
| • Soil test not required. • Complete N and P2O5 columns;  K2O column is optional. • Use the P2O5 column to determine application rate (Row K phosphorus column). | | | | • MUST have Soil test < 200 ppm Mehlich 3 P. List soil test values below. • Complete N column; P2O5 and K2O columns are optional. • Use the N column to determine application rate (Row K nitrogen column). | | | | | | | |
| **Soil Test P (ppm)**  **(**Mehlich 3) | | | **154** | | | | |
| **Manure Group** | | | **Manure Type**  **(Poultry, Swine, Other, Compost)** | | | **Application Season** | | | | **Application Management** | | |
| **Broiler** | | | **Poultry** | | | **Spring** | | | | **No incorporation** | | |
| **Manure Analysis**  **Units** (Circle)  **NH4-N Organic N P2O5**  **K2O** . | | | | | | | | | | | **Manure % Solids** | |
| **lb/ton or lb/1000 gal** | | **31.2** | | **23.1** | | **33.1** | | | **61.8** | | **71.7** | |
| **Notes** |  | | | | | | | | | | | |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **N** | | **P2O5** | **K2O** | **Recommendation Basis** | |
| **A) Recommendation or Removal** (lb/A)  N – Soil Test or Tables 1 & 2 (AG Table 1.2-3;1.2-5)  P2O5 & K2O – Soil Test or Table 3 (AG Table 1.2-6) | **150** | | **0** | **0** | x | Soil Tests |
|  | Crop Removal |
| **B) Fertilizer Applied** (lb/A)  (Regardless of Manure e.g. Starter) | **15** | | **30** | **30** | **Application Record & Notes**  Record when the planned manure and fertilizer rates were applied or note changes. | |
| **C) Other Organic Sources Applied** (lb/A)  (e.g. Biosolids, Other Manure) | **0** | | **0** | **0** |
| **D) Residual Manure N** (lb/A)  Table 4 (AG Table 1.2-11) | **35** | |  |  | Manure Residual N:  Summer crop with manure applied 4-5 of 5 yrs = 35 lbs. N.  Previous legume N: Soybeans (50 bu/ac)  N availability factors from Table 6: Poultry manure, spring applied with no incorporation.  Negative values indicate excess nutrients. | |
| **E) Previous Legume N** (lb/A)  Table 5 (AG Table 1.2-4) or Soil Test Report | **50** | |  |  |
| **F) Net Nutrient Requirement** (lb/A)  (A – B – C – D – E) | **50** | | **-30** | **-30** |
| **G) Manure Analysis**  (lb/ton or lb/1000gal) | NH4-N  **31.2** | Org N  **23.1** | **33.1** | **61.8** |
| H) Nitrogen Availability Factors  Table 6 (AG Table 1.2-12) | NH4-N  **0.2** | Org N  **0.5** |  |  |
| I) Available Nitrogen Fractions  (lb/ton or lb/1000gal) (G x H) | NH4-N  **6.24** | Org N  **11.55** |  |  |
| **J) Total Available Nitrogen**  (sum of Available N Fractions from row I) | NH4-N + Org N  **17.79** | |  |  |
| **K) Balanced Manure Rate-** (tons/A or gallons/A)  Solid manure- For N: (F ÷ J); For P: (F ÷ G)  Liquid manure- For N: (F ÷ J) x 1000; For P: (F ÷ G) x 1000 | **2.8** | | **--** |  |
| **L) Planned Manure Rate** (tons/A or gallons/A)  Must be less than or equal to Row K Balanced Rate and based on the plan basis being used | **2** | | | |
| **M) Nutrients Applied at Planned Rate** (lb/A)  Solid manure- For N: (L x J); For P & K: (L x G)  Liquid manure- For N: (L x J) ÷ 1000; For P & K: (L x G) ÷ 1000 | **36** | | **66** | **124** | **Note:** Nutrient balances for P2O5 and K2O based on crop removal (Row A) should not be used to determine additional fertilizer needs. Only recommendations based on soil tests should be used for this purpose. | |
| **N) Nutrient Balance at Planned Rate**  (lb/A) (F - M) (Indicate short or excess) | **14** | | **-96** | **-154** |

**Manure Management Plan Nutrient Balance Worksheet**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Crop Group** | | | | | **Yield** | | **CMU/Field Identification**  (Each field must be clearly identified on a map) | | | | | **Acres** |
| **Corn after Alfalfa: N-based** | | | | | **175 bu/A** | | **1 – 8** | | | | | **90** |
| **Manure Plan Basis**  (check planning option) | **OPTION 1: P Removal** | | |  | **OPTION 2: N Requirement** | | | | | | | **X** |
| * • Soil test not required. • Complete N and P2O5 columns;  K2O column is optional. • Use the P2O5 column to determine application rate (Row K phosphorus column). | | | | • MUST have Soil test < 200 ppm Mehlich 3 P. List soil test values below. • Complete N column; P2O5 and K2O columns are optional. • Use the N column to determine application rate (Row K nitrogen column). | | | | | | | |
| **Soil Test P (ppm)**  **(**Mehlich 3) | | | **154** | | | | |
| **Manure Group** | | | **Manure Type**  **(Poultry, Swine, Other, Compost)** | | | **Application Season** | | | | **Application Management** | | |
| **Swine Siegrist Spring** | | | **Swine** | | | **Spring** | | | | **No Incorporation** | | |
| **Manure Analysis**  **Units** (Circle)  **NH4-N Organic N P2O5**  **K2O** . | | | | | | | | | | | **Manure % Solids** | |
| **lb/ton or lb/1000 gal** | | **18.3** | | **12.1** | | **22.1** | | | **16.1** | | **4.2** | |
| **Notes** |  | | | | | | | | | | | |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **N** | | **P2O5** | **K2O** | **Recommendation Basis** | |
| **A) Recommendation or Removal** (lb/A)  N – Soil Test or Tables 1 & 2 (AG Table 1.2-3;1.2-5)  P2O5 & K2O – Soil Test or Table 3 (AG Table 1.2-6) | **175** | | **0** | **0** | x | Soil Tests |
|  | Crop Removal |
| **B) Fertilizer Applied** (lb/A)  (Regardless of Manure e.g. Starter) | **10** | | **20** | **20** | **Application Record & Notes**  Record when the planned manure and fertilizer rates were applied or note changes. | |
| **C) Other Organic Sources Applied** (lb/A)  (e.g. Biosolids, Other Manure) | **0** | | **0** | **0** |
| **D) Residual Manure N** (lb/A)  Table 4 (AG Table 1.2-11) | **20** | |  |  | Manure Residual N:  Summer crop with manure applied 2-3 of 5 yrs = 20 lbs. N.  Legume Residual N:  Previous legume was alfalfa <25% stand = 40lbs N  N availability factors from Table 6: Swine manure (<5% solids), spring applied with no incorporation.  Negative values indicate excess nutrients. | |
| **E) Previous Legume N** (lb/A)  Table 5 (AG Table 1.2-4) or Soil Test Report | **40** | |  |  |
| **F) Net Nutrient Requirement** (lb/A)  (A – B – C – D – E) | **105** | | **-20** | **-20** |
| **G) Manure Analysis**  (lb/ton or lb/1000gal) | NH4-N  **18.3** | Org N  **12.1** | **22.1** | **16.1** |
| H) Nitrogen Availability Factors  Table 6 (AG Table 1.2-12) | NH4-N  **0.30** | Org N  **0.50** |  |  |
| I) Available Nitrogen Fractions  (lb/ton or lb/1000gal) (G x H) | NH4-N  **5.49** | Org N  **6.05** |  |  |
| **J) Total Available Nitrogen**  (sum of Available N Fractions from row I) | NH4-N + Org N  **11.54** | |  |  |
| **K) Balanced Manure Rate-** (tons/A or gallons/A)  Solid manure- For N: (F ÷ J); For P: (F ÷ G)  Liquid manure- For N: (F ÷ J) x 1000; For P: (F ÷ G) x 1000 | **11,265** | | **---** |  |
| **L) Planned Manure Rate** (tons/A or gallons/A)  Must be less than or equal to Row K Balanced Rate and based on the plan basis being used | **7500 gal/A** | | | |
| **M) Nutrients Applied at Planned Rate** (lb/A)  Solid manure- For N: (L x J); For P & K: (L x G)  Liquid manure- For N: (L x J) ÷ 1000; For P & K: (L x G) ÷ 1000 | **87** | | **166** | **121** | **Note:** Nutrient balances for P2O5 and K2O based on crop removal (Row A) should not be used to determine additional fertilizer needs. Only recommendations based on soil tests should be used for this purpose. | |
| **N) Nutrient Balance at Planned Rate**  (lb/A) (F - M) (Indicate short or excess) | **18** | | **-186** | **-141** |

**Manure Management Plan Nutrient Balance Worksheet**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Crop Group** | | | | | **Yield** | | **CMU/Field Identification**  (Each field must be clearly identified on a map) | | | | | **Acres** |
| **Corn after Alfalfa- P based** | | | | | **175 bu/A** | | **1 – 8** | | | | | **90** |
| **Manure Plan Basis**  (check planning option) | **OPTION 1: P Removal** | | | **X** | **OPTION 2: N Requirement** | | | | | | |  |
| * • Soil test not required. • Complete N and P2O5 columns;  K2O column is optional. • Use the P2O5 column to determine application rate (Row K phosphorus column). | | | | • MUST have Soil test < 200 ppm Mehlich 3 P. List soil test values below. • Complete N column; P2O5 and K2O columns are optional. • Use the N column to determine application rate (Row K nitrogen column). | | | | | | | |
| **Soil Test P (ppm)**  **(**Mehlich 3) | | |  | | | | |
| **Manure Group** | | | **Manure Type**  **(Poultry, Swine, Other, Compost)** | | | **Application Season** | | | | **Application Management** | | |
| **Swine Siegrist Spring** | | | **Swine** | | | **Spring** | | | | **No Incorporation** | | |
| **Manure Analysis**  **Units** (Circle)  **NH4-N Organic N P2O5**  **K2O** . | | | | | | | | | | | **Manure % Solids** | |
| **lb/ton or lb/1000 gal** | | **18.3** | | **12.1** | | **22.1** | | | **16.1** | | **4.2** | |
| **Notes** |  | | | | | | | | | | | |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **N** | | **P2O5** | **K2O** | **Recommendation Basis** | |
| **A) Recommendation or Removal** (lb/A)  N – Soil Test or Tables 1 & 2 (AG Table 1.2-3;1.2-5)  P2O5 & K2O – Soil Test or Table 3 (AG Table 1.2-6) | **175** | | **70** | **50** |  | Soil Tests |
| x | Crop Removal |
| **B) Fertilizer Applied** (lb/A)  (Regardless of Manure e.g. Starter) | **0** | | **0** | **0** | **Application Record & Notes**  Record when the planned manure and fertilizer rates were applied or note changes. | |
| **C) Other Organic Sources Applied** (lb/A)  (e.g. Biosolids, Other Manure) | **0** | | **0** | **0** |
| **D) Residual Manure N** (lb/A)  Table 4 (AG Table 1.2-11) | **20** | |  |  | Manure Residual N:  Summer crop with manure applied 2-3 of 5 yrs = 20 lbs. N.  Legume Residual N:  Previous legume was alfalfa <25% stand = 40lbs N  N availability factors from Table 6: Swine manure (<5% solids), spring applied with no incorporation. | |
| **E) Previous Legume N** (lb/A)  Table 5 (AG Table 1.2-4) or Soil Test Report | **40** | |  |  |
| **F) Net Nutrient Requirement** (lb/A)  (A – B – C – D – E) | **115** | | **70** | **50** |
| **G) Manure Analysis**  (lb/ton or lb/1000gal) | NH4-N  **18.3** | Org N  **12.1** | **22.1** | **16.1** |
| H) Nitrogen Availability Factors  Table 6 (AG Table 1.2-12) | NH4-N  **0.30** | Org N  **0.50** |  |  |
| I) Available Nitrogen Fractions  (lb/ton or lb/1000gal) (G x H) | NH4-N  **5.49** | Org N  **6.05** |  |  |
| **J) Total Available Nitrogen**  (sum of Available N Fractions from row I) | NH4-N + Org N  **11.54** | |  |  |
| **K) Balanced Manure Rate-** (tons/A or gallons/A)  Solid manure- For N: (F ÷ J); For P: (F ÷ G)  Liquid manure- For N: (F ÷ J) x 1000; For P: (F ÷ G) x 1000 | **---** | | **3,167** |  |
| **L) Planned Manure Rate** (tons/A or gallons/A)  Must be less than or equal to Row K Balanced Rate and based on the plan basis being used | **3,000 gal/A** | | | |
| **M) Nutrients Applied at Planned Rate** (lb/A)  Solid manure- For N: (L x J); For P & K: (L x G)  Liquid manure- For N: (L x J) ÷ 1000; For P & K: (L x G) ÷ 1000 | **35** | | **66** | **48** | **Note:** Nutrient balances for P2O5 and K2O based on crop removal (Row A) should not be used to determine additional fertilizer needs. Only recommendations based on soil tests should be used for this purpose. | |
| **N) Nutrient Balance at Planned Rate**  (lb/A) (F - M) (Indicate short or excess) | **80** | | **4** | **6** |

**Additional Management Scenarios**

Determining a planned application rate for a crop group can often be done within a single worksheet. However, some management scenarios may require more than one worksheet or extra calculations outside of the worksheet. Examples of double crops, multiple manure applications and mechanical application of manure to pastures are described below.

**Example 5: Double Crop- Barley (winter crop) followed by soybeans (summer crop), Option 2.** Liquid swine manure will be applied (no incorporation) in early fall to barley and in summer to soybeans.

The planning approach for double crops requires using a separate worksheet for both the first crop (winter crop) and the second crop (summer crop). The planning procedure is the same as for a single crop except for three specific aspects:

* The residual manure N is divided between both the first and second crops according to information in Table 4.
* The previous legume N is allocated only to the second crop.
* A proportion of the manure N and any excess P or K applied to the winter crop must be credited to the second crop.

Following is the guidance for planning a double crop using the Nutrient Balance Worksheets.

1. Complete a worksheet for the winter crop.
2. Use the appropriate manure residual N values for winter crops in a double crop system from Table 4 (Agronomy Guide Table 1.2-11).

For this example, the winter barley has a frequent manure history (manure applied 2-3 of the last 5 years) so the residual manure N to a winter crop would be 7 lbs N per acre.

1. If the crop is following a legume crop, there is no allocation of the legume residual N to the winter crop. The total legume residual N value will be allocated to the summer crop.

For this example, the winter barley did not have previous legume crop.

1. After completing the worksheet for the winter crop, calculate the **carryover organic N** from the manure applied to the winter crop that must be credited to the summer crop as follows:
   1. Look up the appropriate organic N availability factor in Table 6 (Agronomy Guide Table 1.2-12). The availability factor must reflect appropriate manure application season and summer crop utilization for organic N.

For the winter barley followed by soybeans example with liquid swine manure, the organic N availability factor is ***0.25***. This comes from the second page of Table 6, in the section “Early and Late Fall/ Winter/ Early Spring application for a following summer crop in a double crop system.”

* 1. Multiply the *Planned Manure Rate* (Row L) times the *Manure Organic Nitrogen Content* (Row G) times the availability factors determined above in a. For the winter barley example the calculation would be:

Planned Rate = 5000 gallons swine manure per acre  
Manure Organic N Content =

Double Crop N Carryover =

The **organic nitrogen carryover** is **15 lb N/acre.**

* 1. The N Carryover from the winter crop manure application should be entered in the N column for ***Other Organic Sources Applied* (Row C)** in the ***second worksheet*** for the summer crop. In addition, any **excess P and/or K** that is applied at the planned rate (negative numbers in the P2O5 or K2O columns in Row N) should be entered as positive numbers in the appropriate column for *Other Organic Sources Applied* (Row C) in the worksheet for the summer crop.

1. Complete the worksheet for the summer crop.
2. Use the appropriate manure residual N values for summer crops in a double crop system from Table 4 (Agronomy Guide Table 1.2-11).

For this example with a frequent manure history, the residual manure N for a summer crop in a double crop system is 13 lbs N per acre.

1. If the crop is following a legume crop, allocate the total legume residual N value from Table 5 (Agronomy Guide Table 1.2-4) to the summer crop.

In the second worksheet for soybeans, although the nitrogen applied in manure (Row M) is less than the net nutrient requirement (Row F), the nitrogen balance is zero since a legume would not need N fertilizer.

It is important to note that these two crops are now linked together. The carryover N, P, and K for the summer crop only applies if it is following this specific winter crop. That distinction needs to be clear in the Manure Management Plan Summary. In addition, it may be helpful to include the winter and summer crop information in the crop group name. For example: “Barley (Winter) and Soybeans (Summer).

There may be situations where the winter crop may be followed by different summer crops on different fields on the farm. In that case, as long as the management used on the winter crop does not change, only one worksheet needs to be winter crop needs to be completed for the winter crop. The carryover nutrients from that winter crop may be applied to multiple summer crops that follow it.

**Manure Management Plan Nutrient Balance Worksheet**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Crop Group** | | | | | **Yield** | | **CMU/Field Identification**  (Each field must be clearly identified on a map) | | | | | **Acres** |
| **Double crop- barley (winter)** | | | | | **60 bu/A** | | **1-8** | | | | | **90** |
| **Manure Plan Basis**  (check planning option) | **OPTION 1: P Removal** | | |  | **OPTION 2: N Requirement** | | | | | | | **X** |
| * • Soil test not required. • Complete N and P2O5 columns;  K2O column is optional. • Use the P2O5 column to determine application rate (Row K phosphorus column). | | | | • MUST have Soil test < 200 ppm Mehlich 3 P. List soil test values below. • Complete N column; P2O5 and K2O columns are optional. • Use the N column to determine application rate (Row K nitrogen column). | | | | | | | |
| **Soil Test P (ppm)**  **(**Mehlich 3) | | | **154** | | | | |
| **Manure Group** | | | **Manure Type**  **(Poultry, Swine, Other, Compost)** | | | **Application Season** | | | | **Application Management** | | |
| **Swine Siegrist Fall** | | | **Swine** | | | **Early Fall** | | | | **No Incorporation** | | |
| **Manure Analysis**  **Units** (Circle)  **NH4-N Organic N P2O5**  **K2O** . | | | | | | | | | | | **Manure % Solids** | |
| **lb/ton or lb/1000 gal** | | **18.3** | | **12.1** | | **22.1** | | | **16.1** | | **4.1** | |
| **Notes** |  | | | | | | | | | | | |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **N** | | **P2O5** | **K2O** | **Recommendation Basis** | |
| **A) Recommendation or Removal** (lb/A)  N – Soil Test or Tables 1 & 2 (AG Table 1.2-3;1.2-5)  P2O5 & K2O – Soil Test or Table 3 (AG Table 1.2-6) | **55** | | **0** | **0** | **X** | Soil Tests |
|  | Crop Removal |
| **B) Fertilizer Applied** (lb/A)  (Regardless of Manure e.g. Starter) | **0** | | **0** | **0** | **Application Record & Notes**  Record when the planned manure and fertilizer rates were applied or note changes. | |
| **C) Other Organic Sources Applied** (lb/A)  (e.g. Biosolids, Other Manure) | **0** | | **0** | **0** |
| **D) Residual Manure N** (lb/A)  Table 4 (AG Table 1.2-11) | **7** | |  |  | Residual manure is for winter crop in double crop with Manure applied last 2-3 of 5 yrs is 7lbs N.  Calculate Carryover Organic N available to next year’s soybeans (summer crop in this double crop scenario):  12.1 lb N X 5000 gal = 60.5 lb N  1000 gal. acre acre  60.5 lb N X 0.25 Org N avail. Factor  Acre  = 15.1 = **15 lbs**  **Double Crop N Carryover to soybean worksheet**  Negative values indicate excess nutrients. | |
| **E) Previous Legume N** (lb/A)  Table 5 (AG Table 1.2-4) or Soil Test Report | **0** | |  |  |
| **F) Net Nutrient Requirement** (lb/A)  (A – B – C – D – E) | **48** | | **0** | **0** |
| **G) Manure Analysis**  (lb/ton or lb/1000gal) | NH4-N  **18.3** | Org N  **12.1** | **22.1** | **16.1** |
| H) Nitrogen Availability Factors  Table 6 (AG Table 1.2-12) | NH4-N  **0.30** | Org N  **0.30** |  |  |
| I) Available Nitrogen Fractions  (lb/ton or lb/1000gal) (G x H) | NH4-N  **5.49** | Org N  **3.63** |  |  |
| **J) Total Available Nitrogen**  (sum of Available N Fractions from row I) | NH4-N + Org N  **9.12** | |  |  |
| **K) Balanced Manure Rate-** (tons/A or gallons/A)  Solid manure- For N: (F ÷ J); For P: (F ÷ G)  Liquid manure- For N: (F ÷ J) x 1000; For P: (F ÷ G) x 1000 | **5,263** | | **---** |  |
| **L) Planned Manure Rate** (tons/A or gallons/A)  Must be less than or equal to Row K Balanced Rate and based on the plan basis being used | **5000 gal/A** | | | |
| **M) Nutrients Applied at Planned Rate** (lb/A)  Solid manure- For N: (L x J); For P & K: (L x G)  Liquid manure- For N: (L x J) ÷ 1000; For P & K: (L x G) ÷ 1000 | **46** | | **111** | **81** | **Note:** Nutrient balances for P2O5 and K2O based on crop removal (Row A) should not be used to determine additional fertilizer needs. Only recommendations based on soil tests should be used for this purpose. | |
| **N) Nutrient Balance at Planned Rate**  (lb/A) (F - M) (Indicate short or excess) | **2** | | **-111** | **-81** |

**Manure Management Plan Nutrient Balance Worksheet**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Crop Group** | | | | | **Yield** | | **CMU/Field Identification**  (Each field must be clearly identified on a map) | | | | | **Acres** |
| **Double crop- soybeans (summer)** | | | | | **50 bu/A** | | **1-8** | | | | | **90** |
| **Manure Plan Basis**  (check planning option) | **OPTION 1: P Removal** | | |  | **OPTION 2: N Requirement** | | | | | | | **X** |
| * • Soil test not required. • Complete N and P2O5 columns;  K2O column is optional. • Use the P2O5 column to determine application rate (Row K phosphorus column). | | | | • MUST have Soil test < 200 ppm Mehlich 3 P. List soil test values below. • Complete N column; P2O5 and K2O columns are optional. • Use the N column to determine application rate (Row K nitrogen column). | | | | | | | |
| **Soil Test P (ppm)**  **(**Mehlich 3) | | | **154** | | | | |
| **Manure Group** | | | **Manure Type**  **(Poultry, Swine, Other, Compost)** | | | **Application Season** | | | | **Application Management** | | |
| **Swine Siegrist Fall** | | | **Swine** | | | **Summer** | | | | **No Incorporation** | | |
| **Manure Analysis**  **Units** (Circle)  **NH4-N Organic N P2O5**  **K2O** . | | | | | | | | | | | **Manure % Solids** | |
| **lb/ton or lb/1000 gal** | | **18.3** | | **12.1** | | **22.1** | | | **16.1** | | **4.1** | |
| **Notes** |  | | | | | | | | | | | |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **N** | | **P2O5** | **K2O** | **Recommendation Basis** | |
| **A) Recommendation or Removal** (lb/A)  N – Soil Test or Tables 1 & 2 (AG Table 1.2-3;1.2-5)  P2O5 & K2O – Soil Test or Table 3 (AG Table 1.2-6) | **160** | | **0** | **0** | **X** | Soil Tests |
|  | Crop Removal |
| **B) Fertilizer Applied** (lb/A)  (Regardless of Manure e.g. Starter) | **0** | | **0** | **0** | **Application Record & Notes**  Record when the planned manure and fertilizer rates were applied or note changes. | |
| **C) Other Organic Sources Applied** (lb/A)  (e.g. Biosolids, Other Manure) | **15** | | **-111** | **-81** |
| **D) Residual Manure N** (lb/A)  Table 4 (AG Table 1.2-11) | **13** | |  |  | Other organic sources (Row C) are transferred from winter crop.  15 lbs N is carryover organic N from manure applied to barley the previous fall (calculation provided on barley worksheet).  For P2O5 & K2O, values in Row C are transferred from the barley worksheet (Row N).  Residual manure is for a summer crop in double crop.  In Row N, the N balance is zero since legumes don’t need additional nitrogen but will utilize it if applied.  Negative values indicate excess nutrients. | |
| **E) Previous Legume N** (lb/A)  Table 5 (AG Table 1.2-4) or Soil Test Report | **0** | |  |  |
| **F) Net Nutrient Requirement** (lb/A)  (A – B – C – D – E) | **132** | | **-111** | **-81** |
| **G) Manure Analysis**  (lb/ton or lb/1000gal) | NH4-N  **18.3** | Org N  **12.1** | **22.1** | **16.1** |
| H) Nitrogen Availability Factors  Table 6 (AG Table 1.2-12) | NH4-N  **0.30** | Org N  **0.50** |  |  |
| I) Available Nitrogen Fractions  (lb/ton or lb/1000gal) (G x H) | NH4-N  **5.49** | Org N  **6.05** |  |  |
| **J) Total Available Nitrogen**  (sum of Available N Fractions from row I) | NH4-N + Org N  **11.54** | |  |  |
| **K) Balanced Manure Rate-** (tons/A or gallons/A)  Solid manure- For N: (F ÷ J); For P: (F ÷ G)  Liquid manure- For N: (F ÷ J) x 1000; For P: (F ÷ G) x 1000 | **11,438** | | **---** |  |
| **L) Planned Manure Rate** (tons/A or gallons/A)  Must be less than or equal to Row K Balanced Rate and based on the plan basis being used | **5000 gal/A** | | | |
| **M) Nutrients Applied at Planned Rate** (lb/A)  Solid manure- For N: (L x J); For P & K: (L x G)  Liquid manure- For N: (L x J) ÷ 1000; For P & K: (L x G) ÷ 1000 | **46** | | **111** | **81** | **Note:** Nutrient balances for P2O5 and K2O based on crop removal (Row A) should not be used to determine additional fertilizer needs. Only recommendations based on soil tests should be used for this purpose. | |
| **N) Nutrient Balance at Planned Rate**  (lb/A) (F - M) (Indicate short or excess) | **0** | | **-222** | **-162** |

**Example 6: Multiple Applications. Grass Hay with two manure applications, Option 2.** Liquid swine manure will be applied twice in spring with no incorporation.

The planning approach for multiple manure applications requires using a separate worksheet for each manure application to one crop group. The planning procedure is the same as for a single application except for one specific aspect:

* After planning the first application, the second application must then be based on the nutrient balance following the first manure application.

Following is the guidance for planning a multiple application using the Nutrient Balance Worksheets.

1. Plan the first application as you would any other field/crop group.
2. For the second application, enter the same Worksheet Information Section information (crop group, manure plan basis, etc.) as for the first application.
3. The same or any other manure group can be chosen for the second application and the selected manure group information entered.
4. ***Important>>>*** For the second application, the *Nutrient Balance at the Planned Rate* (Row N) in the first application is entered into the *Net Nutrients* Requirement (Row F) line for the second application. For this example, the nutrient balance (Row N) for the first application (N:72 lbs/acre, P2O5: -111 lbs/acre, and K2O: -81 lbs/acre) and is entered in Row F for the second application worksheet.
5. ***Important>>>*** For the second application, do not enter any other information in the *Fertilizer Applied* (Row B), *Other Organic Sources Applied* (Row C), *Residual Manure N* (Row D), or *Previous Legume N* (Row E).
6. Enter the *Planned Manure Rate* (Row L) for the second application.
7. Nutrient balances that are “Short” in the *Nutrient Balance at Planned Rate* (Row N) in the second application can be applied as supplemental fertilizer.

It is important to note that these two are now linked together. This scenario can be used on other fields that have the exact same situation. This needs to be clear in the Manure Management Plan Summary. It may be helpful to include the multiple application information in the crop group name. For example: Grass Hay (1st) and Grass Hay (2nd).

**Manure Management Plan Nutrient Balance Worksheet**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Crop Group** | | | | | **Yield** | | **CMU/Field Identification**  (Each field must be clearly identified on a map) | | | | | **Acres** |
| **Grass Hay (1st Manure Application)** | | | | | **3 ton/A** | | **9** | | | | | **16** |
| **Manure Plan Basis**  (check planning option) | **OPTION 1: P Removal** | | |  | **OPTION 2: N Requirement** | | | | | | | **X** |
| * • Soil test not required. • Complete N and P2O5 columns;  K2O column is optional. • Use the P2O5 column to determine application rate (Row K phosphorus column). | | | | • MUST have Soil test < 200 ppm Mehlich 3 P. List soil test values below. • Complete N column; P2O5 and K2O columns are optional. • Use the N column to determine application rate (Row K nitrogen column). | | | | | | | |
| **Soil Test P (ppm)**  **(**Mehlich 3) | | | **93** | | | | |
| **Manure Group** | | | **Manure Type**  **(Poultry, Swine, Other, Compost)** | | | **Application Season** | | | | **Application Management** | | |
| **Swine Siegrist Spring** | | | **Swine** | | | **Spring** | | | | **No Incorporation** | | |
| **Manure Analysis**  **Units** (Circle)  **NH4-N Organic N P2O5**  **K2O** . | | | | | | | | | | | **Manure % Solids** | |
| **lb/ton or lb/1000 gal** | | **18.3** | | **12.1** | | **22.1** | | | **16.1** | | **4.2** | |
| **Notes** |  | | | | | | | | | | | |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **N** | | **P2O5** | **K2O** | **Recommendation Basis** | |
| **A) Recommendation or Removal** (lb/A)  N – Soil Test or Tables 1 & 2 (AG Table 1.2-3;1.2-5)  P2O5 & K2O – Soil Test or Table 3 (AG Table 1.2-6) | **150** | | **0** | **0** | **x** | Soil Tests |
|  | Crop Removal |
| **B) Fertilizer Applied** (lb/A)  (Regardless of Manure e.g. Starter) | **0** | | **0** | **0** | **Application Record & Notes**  Record when the planned manure and fertilizer rates were applied or note changes. | |
| **C) Other Organic Sources Applied** (lb/A)  (e.g. Biosolids, Other Manure) | **0** | | **0** | **0** |
| **D) Residual Manure N** (lb/A)  Table 4 (AG Table 1.2-11) | **20** | |  |  | Residual manure is for a summer crop with manure applied last 2-3 of 5 yrs is 20 lbs N.  Nutrient Balance at Planned Rate will be the net nutrients required starting point for the 2nd manure application.  Negative values indicate excess nutrients. | |
| **E) Previous Legume N** (lb/A)  Table 5 (AG Table 1.2-4) or Soil Test Report | **0** | |  |  |
| **F) Net Nutrient Requirement** (lb/A)  (A – B – C – D – E) | **130** | | **0** | **0** |
| **G) Manure Analysis**  (lb/ton or lb/1000gal) | NH4-N  **18.3** | Org N  **12.1** | **22.1** | **16.1** |
| H) Nitrogen Availability Factors  Table 6 (AG Table 1.2-12) | NH4-N  **0.30** | Org N  **0.50** |  |  |
| I) Available Nitrogen Fractions  (lb/ton or lb/1000gal) (G x H) | NH4-N  **5.49** | Org N  **6.05** |  |  |
| **J) Total Available Nitrogen**  (sum of Available N Fractions from row I) | NH4-N + Org N  **11.54** | |  |  |
| **K) Balanced Manure Rate-** (tons/A or gallons/A)  Solid manure- For N: (F ÷ J); For P: (F ÷ G)  Liquid manure- For N: (F ÷ J) x 1000; For P: (F ÷ G) x 1000 | **11,265** | | **---** |  |
| **L) Planned Manure Rate** (tons/A or gallons/A)  Must be less than or equal to Row K Balanced Rate and based on the plan basis being used | **5,000 gal/A** | | | |
| **M) Nutrients Applied at Planned Rate** (lb/A)  Solid manure- For N: (L x J); For P & K: (L x G)  Liquid manure- For N: (L x J) ÷ 1000; For P & K: (L x G) ÷ 1000 | **58** | | **111** | **81** | **Note:** Nutrient balances for P2O5 and K2O based on crop removal (Row A) should not be used to determine additional fertilizer needs. Only recommendations based on soil tests should be used for this purpose. | |
| **N) Nutrient Balance at Planned Rate**  (lb/A) (F - M) (Indicate short or excess) | **72** | | **-111** | **-81** |

**Manure Management Plan Nutrient Balance Worksheet**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Crop Group** | | | | | **Yield** | | **CMU/Field Identification**  (Each field must be clearly identified on a map) | | | | | **Acres** |
| **Grass Hay (2nd Manure Application)** | | | | | **3 ton/A** | | **9** | | | | | **16** |
| **Manure Plan Basis**  (check planning option) | **OPTION 1: P Removal** | | |  | **OPTION 2: N Requirement** | | | | | | | **X** |
| * • Soil test not required. • Complete N and P2O5 columns;  K2O column is optional. • Use the P2O5 column to determine application rate (Row K phosphorus column). | | | | • MUST have Soil test < 200 ppm Mehlich 3 P. List soil test values below. • Complete N column; P2O5 and K2O columns are optional. • Use the N column to determine application rate (Row K nitrogen column). | | | | | | | |
| **Soil Test P (ppm)**  **(**Mehlich 3) | | | **93** | | | | |
| **Manure Group** | | | **Manure Type**  **(Poultry, Swine, Other, Compost)** | | | **Application Season** | | | | **Application Management** | | |
| **Swine Siegrist Spring** | | | **Swine** | | | **Spring** | | | | **No Incorporation** | | |
| **Manure Analysis**  **Units** (Circle)  **NH4-N Organic N P2O5**  **K2O** . | | | | | | | | | | | **Manure % Solids** | |
| **lb/ton or lb/1000 gal** | | **18.3** | | **12.1** | | **22.1** | | | **16.1** | | **4.2** | |
| **Notes** |  | | | | | | | | | | | |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **N** | | **P2O5** | **K2O** | **Recommendation Basis** | |
| **A) Recommendation or Removal** (lb/A)  N – Soil Test or Tables 1 & 2 (AG Table 1.2-3;1.2-5)  P2O5 & K2O – Soil Test or Table 3 (AG Table 1.2-6) | **--** | | **--** | **--** | **x** | Soil Tests |
|  | Crop Removal |
| **B) Fertilizer Applied** (lb/A)  (Regardless of Manure e.g. Starter) | **--** | | **--** | **--** | **Application Record & Notes**  Record when the planned manure and fertilizer rates were applied or note changes. | |
| **C) Other Organic Sources Applied** (lb/A)  (e.g. Biosolids, Other Manure) | **--** | | **--** | **--** |
| **D) Residual Manure N** (lb/A)  Table 4 (AG Table 1.2-11) | **--** | |  |  | The net nutrients required is starting point for the 2nd manure application.  The values are from the nutrient balance at the planned rate after first manure application.  Negative values indicate excess nutrients. | |
| **E) Previous Legume N** (lb/A)  Table 5 (AG Table 1.2-4) or Soil Test Report | **--** | |  |  |
| **F) Net Nutrient Requirement** (lb/A)  (A – B – C – D – E) | **72** | | **-111** | **-81** |
| **G) Manure Analysis**  (lb/ton or lb/1000gal) | NH4-N  **18.3** | Org N  **12.1** | **22.1** | **16.1** |
| H) Nitrogen Availability Factors  Table 6 (AG Table 1.2-12) | NH4-N  **0.30** | Org N  **0.50** |  |  |
| I) Available Nitrogen Fractions  (lb/ton or lb/1000gal) (G x H) | NH4-N  **5.49** | Org N  **6.05** |  |  |
| **J) Total Available Nitrogen**  (sum of Available N Fractions from row I) | NH4-N + Org N  **11.54** | |  |  |
| **K) Balanced Manure Rate-** (tons/A or gallons/A)  Solid manure- For N: (F ÷ J); For P: (F ÷ G)  Liquid manure- For N: (F ÷ J) x 1000; For P: (F ÷ G) x 1000 | **6,239** | | **---** |  |
| **L) Planned Manure Rate** (tons/A or gallons/A)  Must be less than or equal to Row K Balanced Rate and based on the plan basis being used | **5,000 gal/A** | | | |
| **M) Nutrients Applied at Planned Rate** (lb/A)  Solid manure- For N: (L x J); For P & K: (L x G)  Liquid manure- For N: (L x J) ÷ 1000; For P & K: (L x G) ÷ 1000 | **58** | | **111** | **81** | **Note:** Nutrient balances for P2O5 and K2O based on crop removal (Row A) should not be used to determine additional fertilizer needs. Only recommendations based on soil tests should be used for this purpose. | |
| **N) Nutrient Balance at Planned Rate**  (lb/A) (F - M) (Indicate short or excess) | **14** | | **-222** | **-162** |

**Example 7: Planning for a pasture with mechanically applied manure.**

Scenario: A farmer wants to apply liquid swine manure to a pasture grazed by sheep. The pasture is grazed by 100 merino sheep for 120 days during the year (April – July). The sheep are on pasture 24 hours/day with no access to a barn. The pasture is 20.25 acres with no well near the pasture. The farmer does not have a soil test. The field is mixed grasses and the yield is estimated as 3 tons/acre. The field does not have any manure application setback criteria for wells, sinkholes or surface water.

For pastures where additional manure will be mechanically applied with a spreader, this can be treated as a multiple application using the instructions above. The uncollected manure deposited by grazing animals can be treated as the first application and the mechanically applied manure will be the second application. Completing the first worksheet for the uncollected manure will require gathering information about the pasture and consulting technical resources to obtain book values for animal weights, manure production and manure nutrient content. The instructions below explain how to complete the first application worksheet for the uncollected manure in a pasture.

**Step 1 – Gather the following information about animals grazing on the pasture:**

Animal Information-

* + Animals using the pasture: Animal types, weights or ages
  + Grazing Information: When the animals are on the pasture (months of the year, days and hours per day)
  + This information will be used to determine the uncollected manure amount produced and manure nutrient content based on book values (Table 7).

Field information

* + Acres
  + Soil test if available
  + Crop grazed and estimated crop yield
  + Field Setbacks – Wells, sink holes, surface water

Manure information (for mechanically applied manure)

* + - Manure Analysis report (if available)
    - Manure book values (Table 7) may be used if an analysis is not available.

**Step 2- Consult Technical References to obtain information as needed:**

* + Standard Animal Weights- Penn State Extension Agronomy Facts 54: <https://extension.psu.edu/pennsylvanias-nutrient-management-act-act-38-who-is-affected>
  + Estimating Forage Yields for Pastures: <https://extension.psu.edu/programs/nutrient-management/planning-resources/other-planning-resources/estimating-forage-yields-for-pastures>

**Step 3- Calculate the amount in uncollected manure deposited by grazing animals:**

1. Use standard animal weights to calculate the number of Animal Units (AU) for each group of animals:

In Agronomy Facts 54, the standard weight for ewes (medium breed) is 175 lbs.

1. Use the daily manure production (Table 7) for each group of animals to calculate the amount of uncollected manure for that animal group’s time on the pasture:

**Note:** Determining Hours Per Day on Pasture when animals have free access to a pasture and a barn.

* + If the animals are both fed and watered at the barn, use 12 hours per day on pasture instead of 24 hours.
  + If animals are either fed or watered at the barn while the other (feed or water) is provided in the pasture, use 18 hours per day on pasture instead of 24 hours.

Based on Table 7, sheep and goats produce 40 lbs manure/AU/day:

1. Calculate the rate (tons per acre) of uncollected manure:

**Step 4- Use the collected information and calculated manure rate to complete the worksheet for the uncollected manure.** For pastures, use book values from Table 7 for manure nutrient content. For the availability factors in Row H, use the grazing row in Table 6.

For the uncollected sheep manure, the nutrient content from Table 7 is:

Total N: 23 lbs/ton

NH4-N : 1 lb/ton

P2O5 : 8 lbs/ton

K2O : 20 lbs/ton

Dry matter : 25%

The Organic N for Row G is calculated by subtracting NH4-N from Total N:

From Table 6, the nitrogen availability factors for grazing sheep are 0.2 for both NH4-N and Organic N.

**Step 5-** **Complete the second worksheet for the mechanically-applied manure.** This example uses liquid swine manure applied in early fall with no incorporation.

The first worksheet indicates that after accounting for the nutrients in the uncollected sheep manure, the Nutrient Balance for this pasture is 105 lbs/acre for N, 28 lbs/acre for P2O5 and 109 lbs/acre for K2O. Because there is no soil test for the pasture, mechanically-applied swine liquid will be limited to a rate that does not exceed 28 lbs per acre for P2O5.

In the second worksheet, the crop nutrient requirement in Row A matches the information in row N of the first worksheet. For this scenario, 1000 gallons per acre was selected as the planned application rate to remain below the P balanced rate of 1365 gallons per acre in row K.

Note that the Nitrogen balanced rate for this pasture is 11, 586 gallons per acre. If the pasture had a soil test that was less than 200 ppm P (Mehlich 3 test), the farmer would be able to select Option 2 (Nitrogen based planning). This would allow a higher application rate for the swine manure.

**Manure Management Plan Nutrient Balance Worksheet**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Crop Group** | | | | | **Yield** | | **CMU/Field Identification**  (Each field must be clearly identified on a map) | | | | | **Acres** |
| **Pasture, mixed grasses** | | | | | **3 T/ac** | | **10** | | | | | **20.25** |
| **Manure Plan Basis**  (check planning option) | **OPTION 1: P Removal** | | | **X** | **OPTION 2: N Requirement** | | | | | | |  |
| • Soil test not required. • Complete N and P2O5 columns;  K2O column is optional. • Use the P2O5 column to determine application rate (Row K phosphorus column). | | | | • MUST have Soil test < 200 ppm Mehlich 3 P. List soil test values below. • Complete N column; P2O5 and K2O columns are optional. • Use the N column to determine application rate (Row K nitrogen column). | | | | | | | |
| **Soil Test P (ppm)**  **(**Mehlich 3) | | | **N/A** | | | | |
| **Manure Group** | | | **Manure Type**  **(Poultry, Swine, Other, Compost)** | | | **Application Season** | | | | **Application Management** | | |
| **Ewes uncollected** | | | **Other** | | | **Spring/Summer** | | | | **Grazing** | | |
| **Manure Analysis**  **Units** (Circle)  **NH4-N Organic N P2O5**  **K2O** . | | | | | | | | | | | **Manure % Solids** | |
| **lb/ton or lb/1000 gal** | | **1** | | **22** | | **8** | | | **20** | | **25** | |
| **Notes** |  | | | | | | | | | | | |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **N** | | **P2O5** | **K2O** | **Recommendation Basis** | |
| **A) Recommendation or Removal** (lb/A)  N – Soil Test or Tables 1 & 2 (AG Table 1.2-3;1.2-5)  P2O5 & K2O – Soil Test or Table 3 (AG Table 1.2-6) | **150** | | **45** | **150** |  | Soil Tests |
| x | Crop Removal |
| **B) Fertilizer Applied** (lb/A)  (Regardless of Manure e.g. Starter) | **0** | | **0** | **0** | **Application Record & Notes**  Record when the planned manure and fertilizer rates were applied or note changes. | |
| **C) Other Organic Sources Applied** (lb/A)  (e.g. Biosolids, Other Manure) | **0** | | **0** | **0** |
| **D) Residual Manure N** (lb/A)  Table 4 (AG Table 1.2-11) | **35** | |  |  | Residual manure is for a summer crop with manure applied last 4-5 of 5 yrs is 35 lbs N.  Manure analysis is from Table 7.  Nitrogen availability factors are from grazing row in Table 6.  Planned manure rate is calculated as uncollected manure divided by pasture acreage. | |
| **E) Previous Legume N** (lb/A)  Table 5 (AG Table 1.2-4) or Soil Test Report | **0** | |  |  |
| **F) Net Nutrient Requirement** (lb/A)  (A – B – C – D – E) | **115** | | **45** | **150** |
| **G) Manure Analysis**  (lb/ton or lb/1000gal) | NH4-N  **1** | Org N  **22** | **8** | **20** |
| H) Nitrogen Availability Factors  Table 6 (AG Table 1.2-12) | NH4-N  **0.2** | Org N  **0.2** |  |  |
| I) Available Nitrogen Fractions  (lb/ton or lb/1000gal) (G x H) | NH4-N  **0.2** | Org N  **4.4** |  |  |
| **J) Total Available Nitrogen**  (sum of Available N Fractions from row I) | NH4-N + Org N  **4.6** | |  |  |
| **K) Balanced Manure Rate-** (tons/A or gallons/A)  Solid manure- For N: (F ÷ J); For P: (F ÷ G)  Liquid manure- For N: (F ÷ J) x 1000; For P: (F ÷ G) x 1000 | **25** | | **5.6** |  |
| **L) Planned Manure Rate** (tons/A or gallons/A)  Must be less than or equal to Row K Balanced Rate and based on the plan basis being used | **2.07** | | | |
| **M) Nutrients Applied at Planned Rate** (lb/A)  Solid manure- For N: (L x J); For P & K: (L x G)  Liquid manure- For N: (L x J) ÷ 1000; For P: (L x G) ÷ 1000 | **10** | | **17** | **41** | **Note:** Nutrient balances for P2O5 and K2O based on crop removal (Row A) should not be used to determine additional fertilizer needs. Only recommendations based on soil tests should be used for this purpose. | |
| **N) Nutrient Balance at Planned Rate**  (lb/A) (F - M) (Indicate short or excess) | **105** | | **28** | **109** |

**Manure Management Plan Nutrient Balance Worksheet**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Crop Group** | | | | | **Yield** | | **CMU/Field Identification**  (Each field must be clearly identified on a map) | | | | | **Acres** |
| **Pasture, mixed grasses** | | | | | **3 T/ac** | | **10** | | | | | **20.25** |
| **Manure Plan Basis**  (check planning option) | **OPTION 1: P Removal** | | | **X** | **OPTION 2: N Requirement** | | | | | | |  |
| • Soil test not required. • Complete N and P2O5 columns;  K2O column is optional. • Use the P2O5 column to determine application rate (Row K phosphorus column). | | | | • MUST have Soil test < 200 ppm Mehlich 3 P. List soil test values below. • Complete N column; P2O5 and K2O columns are optional. • Use the N column to determine application rate (Row K nitrogen column). | | | | | | | |
| **Soil Test P (ppm)**  **(**Mehlich 3) | | | **N/A** | | | | |
| **Manure Group** | | | **Manure Type**  **(Poultry, Swine, Other, Compost)** | | | **Application Season** | | | | **Application Management** | | |
| **Liquid Swine** | | | **Swine** | | | **Early fall** | | | | **No incorporation** | | |
| **Manure Analysis**  **Units** (Circle)  **NH4-N Organic N P2O5**  **K2O** . | | | | | | | | | | | **Manure % Solids** | |
| **lb/ton or lb/1000 gal** | | **30.21** | | **11.21** | | **20.51** | | | **22.54** | | **4.1** | |
| **Notes** |  | | | | | | | | | | | |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **N** | | **P2O5** | **K2O** | **Recommendation Basis** | |
| **A) Recommendation or Removal** (lb/A)  N – Soil Test or Tables 1 & 2 (AG Table 1.2-3;1.2-5)  P2O5 & K2O – Soil Test or Table 3 (AG Table 1.2-6) | **105** | | **28** | **109** |  | Soil Tests |
| **x** | Crop Removal |
| **B) Fertilizer Applied** (lb/A)  (Regardless of Manure e.g. Starter) | **0** | | **0** | **0** | **Application Record & Notes**  Record when the planned manure and fertilizer rates were applied or note changes. | |
| **C) Other Organic Sources Applied** (lb/A)  (e.g. Biosolids, Other Manure) | **0** | | **0** | **0** |
| **D) Residual Manure N** (lb/A)  Table 4 (AG Table 1.2-11) | **0** | |  |  | Row A was transferred from Row N of previous worksheet for uncollected manure.  N availability factors from Table 6: Swine manure (<5% solids), spring applied with no incorporation. | |
| **E) Previous Legume N** (lb/A)  Table 5 (AG Table 1.2-4) or Soil Test Report | **0** | |  |  |
| **F) Net Nutrient Requirement** (lb/A)  (A – B – C – D – E) | **105** | | **28** | **109** |
| **G) Manure Analysis**  (lb/ton or lb/1000gal) | NH4-N  **11.21** | Org N  **19** | **20.51** | **22.54** |
| H) Nitrogen Availability Factors  Table 6 (AG Table 1.2-12) | NH4-N  **0.3** | Org N  **0.3** |  |  |
| I) Available Nitrogen Fractions  (lb/ton or lb/1000gal) (G x H) | NH4-N  **3.363** | Org N  **5.7** |  |  |
| **J) Total Available Nitrogen**  (sum of Available N Fractions from row I) | NH4-N + Org N  **9.063** | |  |  |
| **K) Balanced Manure Rate-** (tons/A or gallons/A)  Solid manure- For N: (F ÷ J); For P: (F ÷ G)  Liquid manure- For N: (F ÷ J) x 1000; For P: (F ÷ G) x 1000 | **11586** | | **1365** |  |
| **L) Planned Manure Rate** (tons/A or gallons/A)  Must be less than or equal to Row K Balanced Rate and based on the plan basis being used | **1000** | | | |
| **M) Nutrients Applied at Planned Rate** (lb/A)  Solid manure- For N: (L x J); For P & K: (L x G)  Liquid manure- For N: (L x J) ÷ 1000; For P: (L x G) ÷ 1000 | **9** | | **21** | **23** | **Note:** Nutrient balances for P2O5 and K2O based on crop removal (Row A) should not be used to determine additional fertilizer needs. Only recommendations based on soil tests should be used for this purpose. | |
| **N) Nutrient Balance at Planned Rate**  (lb/A) (F - M) (Indicate short or excess) | **96** | | **7** | **86** |