

# Fertilizer Calculator for Pastures in Mississippi: Excel Program (V.05) Instruction Sheet

This Excel-based program provides precise directions for an optimal application of fertilizers to pastures and hay fields in Mississippi when following soil test recommendations. Finding the right combination of fertilizers and their application rates, and mixing different fertilizers and applying them correctly is not easy. Incorrect application could cost yield and economic losses.

The fertilizer calculator is based on vast information and chemical calculations that are not usually available to the grower. It computes the pounds of a given fertilizer required, based on the nutrient ratio of the fertilizer (the three numbers prominently displayed on the fertilizer label, sometimes called the "N-P-K ratio"), and the pounds of nitrogen (N), phosphate ( $P_2O_5$ ), and potash ( $K_2O$ ) necessary for a given area, as recommended by soil test results. To use this calculator, follow these guidelines:

Before beginning, download the fertilizer calculator (<http://extension.msstate.edu/sites/default/files/topic-files/forages/calculator.xls>). Make sure your computer's macro function is enabled. You can change macro security settings in the Trust Center, unless a system administrator in your organization has changed the default settings to prevent you from changing the settings.

- On the Developer tab, in the Code group, click Macro Security. If the Developer tab is not displayed, click the Microsoft Office Button, click Excel Options, and then, in the Popular category, under Top options for working with Excel, click Show Developer tab in the Ribbon.
- In the Macro Settings category, under Macro Settings, click the option you want. Any changes you make in the Macro Settings category in Excel apply only to Excel and do not affect any other Microsoft Office program. You can also access the Trust Center in the Excel Options dialog box. Click the Microsoft Office button, and then click Excel Options. In the Trust Center category, click Trust Center Settings, and then click the Macro Settings category.

**Step 1.** Get the personal information of the producer for whom you are creating a report for record-keeping purposes. Put that information in the yellow highlighted sections of the Excel sheet. A reset button at the top left

corner of the sheet lets you reset the values once you have printed the calculations and analysis.

**Step 2.** Contact your local co-op or fertilizer dealer to get accurate prices on fertilizer types and lime (\$/ton), as well as spreading cost (\$/acre) needed in the calculator sheet.

You will need a soil test analysis to get a more accurate estimate of the amount of nutrients needed to meet the plant's nutrient requirements or the amount of lime needed to neutralize soil pH. Up to 10 pastures can be analyzed on this sheet.

For information on how to collect a soil sample, contact your local Extension office or refer to Extension Information Sheet 346 Soil Testing for the Farmer at <http://extension.msstate.edu/publications/information-sheets/soil-testing-for-the-farmer>.

The cost per sample for a routine soil analysis (pH, lime requirement, N, P, K, Ca, Mg, Zn, and Na) is \$8. Include payment (check or money order) with the sample. Send soil samples to

## MSU Soil Testing Laboratory

Box 9610

Mississippi State, MS 39762

Phone: (662) 325-3313

**Step 3.** The number of pounds for the fertilizer you choose will be calculated automatically for each pasture. Some blends, such as triple 13 (13-13-13) or triple 17 (17-17-17) are included, and their applications are based on soil test recommendations for nitrogen application. If you choose poultry litter as a possible fertilizer, application rates are based on soil test recommendations for nitrogen and assume poultry litter will be broadcast.

**Step 4.** This section provides the fertilizer grade of the fertilizer applied to each specific pasture, based on soil test recommendations.

**Step 5.** This section lets you compare the cost of different fertilizers and determines which one(s) might be more economical. It provides information related to the cost of fertilizer and lime application, the cost per acre, the amounts of fertilizer applied to the whole pasture,

and the total cost per pasture. It also gives the cost of fertilization for the whole farm, depending on the number of pastures.

**Step 6.** This section lets you determine the amount of nutrients (lb) present in a ton of poultry litter. If you use poultry litter as an alternate source of fertilizer, make sure the litter is properly tested close to application time to determine nutrient content.

The analysis you receive from the lab reports nitrogen as percent crude protein (%CP); P is reported as %P; and K is reported as %K.

To determine the percent of nitrogen in the sample as received, divide %CP by 6.25 ( $\%N = \%CP / 6.25$ ).

To find  $P_2O_5$ , multiply %P by 2.29 ( $\%P_2O_5 = \%P \times 2.29$ ).

To get  $K_2O$ , multiply %K by 1.21 ( $\%K_2O = \%K \times 1.21$ ).

The way you apply poultry litter also affects how much nitrogen is available to the plant in the first year of application. If you surface-apply poultry litter and incorporate it (plow or disk) within 2 days of application, approximately 70 percent of the nitrogen could be available, depending on soil and climate conditions.

Send poultry litter samples requiring analysis to

**Mississippi State Chemical Laboratory**

P.O. Box CR

Mississippi State, MS 39762

Phone: (662) 325-3428

Fax: (662) 325-7807

## Nutrient Sources

Many types of fertilizer (both organic and inorganic) may be added to the soil to meet plant nutrient requirements in forage production. Remember that these nutrients should be applied based on soil test recommendations. Commercial fertilizers provide nutrients in relatively concentrated forms (guaranteed analysis), while manure (especially poultry litter) provides fewer nutrients per ton of product, and their concentration could be highly variable.

For any producer to apply fertilizer (commercial or manure), it is important to know which nutrients and the amount of each nutrient the product provides.

When purchasing poultry litter, always request a poultry litter analysis to get an assurance of its nutrient content. In Mississippi, when poultry litter is not tested, a good rule of thumb is to assume that the poultry litter is 80 percent dry matter and contains 3.56 percent N, 1.81 percent  $P_2O_5$ , and 3.69 percent  $K_2O$ . The fertilizer grade is 3-2-3 (57-29-59 pounds of N- $P_2O_5$ - $K_2O$  per ton).

The nutrients in poultry litter are in both mineral and organic forms. This means a proportion of the nitrogen, phosphorus, and potassium is immediately available to plants, while the remainder (organic) must react in the soil to change into a form that is available for plant use. But nutrient availability of litter can vary 30 to 50 percent, depending on the way you apply it.

Assume that 70 percent of the N is available if you incorporate the poultry litter and 50 percent is available if you broadcast it. Remember that a nutrient analysis is encouraged, and applications should be based on soil test recommendations.

**Table 1. Selected fertilizer sources commonly used in Mississippi for forage production.**

Fertilizer	Formula	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	S	Ca	Mg	Effect on soil pH <sup>1</sup>
Ammonium Nitrate	NH <sub>4</sub> NO <sub>3</sub>	34	—	—	—	—	—	+2
Ammonium Sulfate	(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>	21	—	—	24	—	—	+4
Urea Ammonium Sulfate	NH <sub>4</sub> NO <sub>3</sub> (NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>	34	—	—	12	—	—	-4
Urea	CO(NH <sub>2</sub> ) <sub>2</sub>	46	—	—	—	—	—	-2
Urea (sulfur-coated)	CO(NH <sub>2</sub> ) <sub>2</sub> S	—	—	—	—	—	—	-3
UAN Solution	CH <sub>4</sub> N <sub>2</sub> O + NH <sub>4</sub> NO <sub>3</sub> + H <sub>2</sub> O	23–32	—	—	—	—	—	-2
Diammonium Phosphate (DAP)	(NH <sub>4</sub> ) <sub>2</sub> HPO <sub>4</sub>	18	46	—	—	—	—	-3
Monoammonium Phosphate (MAP)	NH <sub>4</sub> H <sub>2</sub> PO <sub>4</sub>	10	52	—	—	—	—	-4
Triple Superphosphate	Ca(H <sub>2</sub> PO <sub>4</sub> ) <sub>2</sub>	—	46	—	2	14	—	none
Muriate of Potash	K <sub>2</sub> O	—	—	60	—	—	—	none
Potassium Sulfate	K <sub>2</sub> SO <sub>4</sub>	—	—	52	18	—	—	-5
Poultry Litter <sup>2</sup>	—	3	3	2	—	—	—	+1
Calcitic Limestone	CaCO <sub>3</sub>	—	—	—	—	36	—	+5
Dolomitic Limestone	CaMg(CO <sub>3</sub> ) <sub>2</sub>	—	—	—	—	24–30	6–12	+5

Note: The fertilizer types and names mentioned on this sheet are for management purposes only. No direct endorsement of these products is intended. Other products containing similar nutrient compositions should provide similar levels of plant-available nutrients based on soil test recommendations.

<sup>1</sup>Numbers indicate an increase (+) or decrease (-) in pH with the type of fertilizer applied. The higher the number, the more substantial the change in pH. The effect of these fertilizers on soil pH also depends on soil texture and the potential for fertilizer leaching, runoff, or volatilization.

<sup>2</sup>Assumes that poultry litter is 80 percent dry matter.

**Table 2. Nitrogen (N) availability coefficients in the first year of poultry litter application.**

Manure Type	Incorporate <sup>1</sup>	Broadcast <sup>2</sup>
All poultry litters	0.7	0.5
Layer	0.6	0.4

<sup>1</sup>Surface-spread manure plowed or disked into soil within 2 days.

<sup>2</sup>Surface-spread manure uncovered for 1 month or longer.

## How to Determine How Much Blended Fertilizer to Apply

You can use the data from the soil test report to determine what blend of fertilizers might supply the needs of the type of forage you are growing.

For example, the following nutrients are recommended (from a soil analysis) for maintaining a 10-acre bermudagrass pasture: 70 lb N/acre, 100 lb P<sub>2</sub>O<sub>5</sub>/acre, and 120 lb K<sub>2</sub>O/acre. The following fertilizer materials are available to supply the nutrient needs: urea (46-0-0), monoammonium phosphate (MAP) (10-52-0), and potash (0-0-60).

### 1. First, calculate the amount of each material that must be blended together to supply the necessary nutrient per acre.

Since MAP contains nitrogen, it is always a good idea to calculate how much nitrogen MAP will provide and then adjust how much urea is needed. Calculate how much MAP is needed. The soil recommendations call for 100 lb P<sub>2</sub>O<sub>5</sub>/acre. MAP has 52% P<sub>2</sub>O<sub>5</sub>.  $P_2O_5 = (100 \text{ lb/acre}) / (0.52) = 192.3 \text{ lb/acre}$ .

Calculate how much urea is needed. Remember that MAP has 10 percent nitrogen available. The amount N that MAP is providing has to be subtracted from the urea. Urea is 46 percent nitrogen. The N recommendation is 70 lb/acre.  $N = [70 \text{ lb/acre} - (192.3 \times 0.11)] / 0.46 = 106.2 \text{ lb/acre}$ .

Calculate how much potash is needed. The soil recommendation for potassium is 120 lb K<sub>2</sub>O/acre, and potash contains 60% K<sub>2</sub>O.  $K_2O = (120 \text{ lb/acre}) / (0.60) = 200 \text{ lb/acre}$ .

**This means that 498.2 lb/acre (192.3 + 106.2 + 200) of fertilizer is needed.**

**2. Second, by using these blends, you can calculate the fertilizer grade that will be needed.** We know the recommended nutrient rates from the soil test, and we know the total fertilizer needed per acre. Calculate the percentage of each fertilizer in the blend.

$$N = [(70 \text{ lb/ac}) / (498.2 \text{ lb/ac})] \times 100 = 14.0$$

$$P_2O_5 = [(100 \text{ lb/ac}) / (498.2 \text{ lb/ac})] \times 100 = 20.0$$

$$K_2O = [(120 \text{ lb/ac}) / (498.2 \text{ lb/ac})] \times 100 = 24.1$$

**The fertilizer grade is 14-20-24 (N-P-K).**

**3. How much of each nutrient is needed to fertilize a 10-acre pasture and what is the cost?**

$$N = (10 \text{ ac}) \times (106.2 \text{ lb/ac}) = 1060 \text{ lb urea.}$$

If the average urea price is \$485/ton, it will cost \$257.05.

$$P_2O_5 = (10 \text{ ac}) \times (192.3 \text{ lb/ac}) = 1923 \text{ lb MAP.}$$

If the average MAP price is \$417/ton, it will cost \$401.

$$K_2O = (10 \text{ ac}) \times (200 \text{ lb/ac}) = 2000 \text{ lb potash.}$$

If the average potash price is \$860/ton, it will cost \$860.

**That means it will cost \$151.80/acre. This does not include fertilizer application per acre.**

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## References

- Chamblee, T., & Todd, R. (2002). Mississippi broiler litter: Fertilizer value and quantity produced. *MAFES Vol. 23*(5): 1–4.
- Hancock, D. W., Harris, G. H., Franks, R. W., Morgan, S. P., & Green, T. W. (2008). *Soil and fertilizer management considerations for forage systems in Georgia*. Univ. of Georgia Coop. Ext. Serv. Bulletin 1346.
- Havlin, J. L., Beaton, J. D., Tisdale, S. L., & Nelson, W. L. (2005). *Soil fertility and fertilizers*. 7th Edition. Upper Saddle River, NJ: Pearson Prentice Hall.

This information is for educational and preliminary planning purposes only. Use this program as a guide only. The calculator uses publicly available information as a basis for its calculations; such information may change over time. Users assume the risk of using or otherwise relying upon any calculator output. The fertilizer types and names mentioned in this publication are for management purposes only. No direct endorsement of these products is intended. Other products containing similar nutrient compositions may provide similar levels of plant-available nutrients based on soil test recommendations.

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