Fertilizer and Lime Math

Hamilton County Green Express
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Robert Florence

SoilLab.Tennessee.edu

SOIL, PLANT & PEST CENTER
UTEXTENSION
INSTITUTE OF AGRICULTURE
THE UNIVERSITY OF TENNESSEE

Fertilizers

SoilLab.Tennessee.edu/fertilizer-calculator

Lime

Fertilizer questions to ask yourself…

What is the lawn nutrient need?

What are the percent nutrients in your fertilizer?

When to apply the fertilizer?

Did you soil test?

Does the bag or bottle know your soil's exact need?

What is in the bag?

Label must be there by law

These are *total* amounts of nutrient

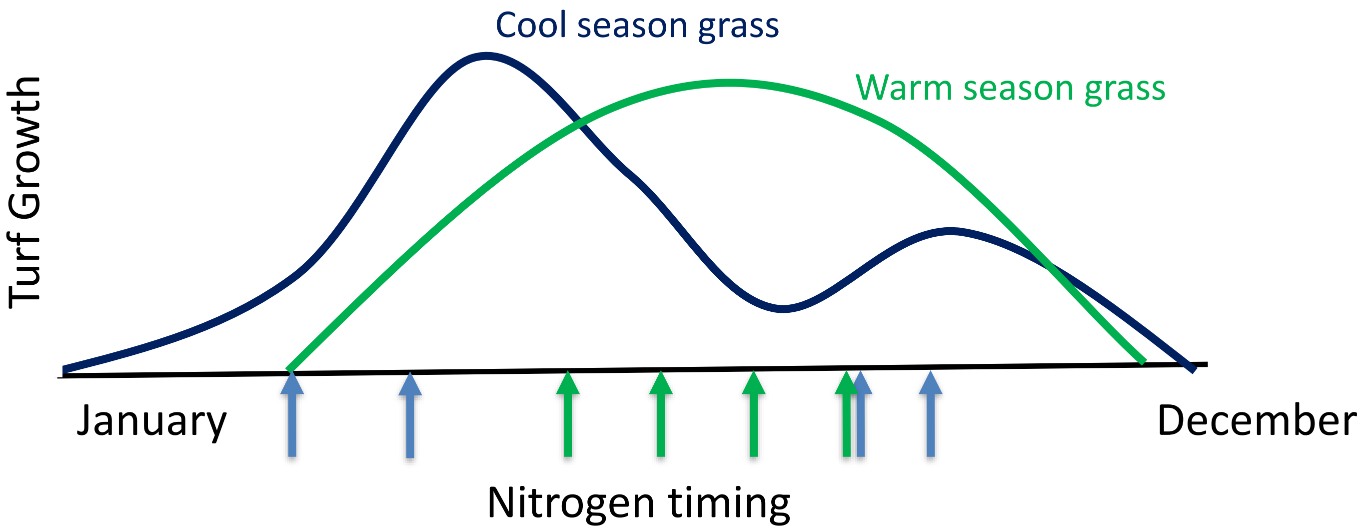
What is the nutrient need?

Recommendations

Crop	Fertilizer				Lime	
	Nitrogen (as N)	Phosphate (as P2O5)	Potash (as K2O)	Rate	As 65% RNV	
Lawn, Cool Season	2 to 4* Split applied	1	0	pounds per 1,000 square feet	180	pounds per 1000 square feet

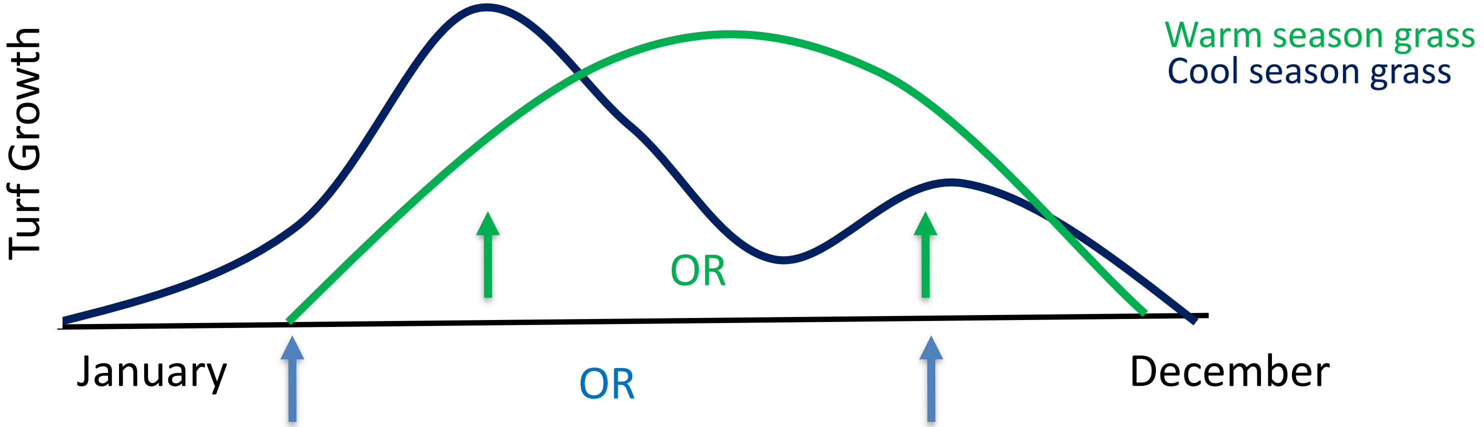
Please read any text below or on next sheet for additional suggestions and resources

Nitrogen Timing



Tom Samples. 2010. Lawn Care: Selecting, Establishing & maintaining the Fescues. UT Extension Publication 1576.
Tom samples, *et al,*. 2007. Bermudagrass Athletic Field Management Calendar. UT Extension Publication 1632.

P and K Timing



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If we know what fertilizer we have
and
what our plant or lawn needs are,

Then the rest is math.

Units can trip people up…

Recommendations are made in and fertilizers sold in N, P_2O_5, and K_20 *equivalents*.

Try not to say “units” without context

As in “I need 100 units of N”

You may only get 100 pounds of product…

Percent by weight of the nutrient *equivalents*

N	-	P_2O_5	-	K_2O
Nitrogen		Phosphorus		Potassium

GROW FAST FERTILIZER

10-10-10

100 POUNDS

100 pounds has…

10 pounds of N equivalent

10 pounds of P_2O_5 equivalent

10 pounds of K_2O equivalent

Fertilizer formulas

To go from a recommendation to pounds of product to apply…

$$\text{Pounds of nutrient Per area} \times \frac{\text{100 pounds product}}{\text{\# pounds of nutrient}} = \text{Pounds of product Per area}$$

To go from pounds applied to how much nutrient was applied…

$$\text{Pounds of product applied per area} \times \frac{\text{\# pounds of nutrient}}{\text{100 pounds of product}} = \text{Pounds of nutrient applied}$$

Nitrogen only need

Lawn need is,

1 pound of N per 1,000 ft^2

We have,

34% N 0% P_2O_5 0% K_2O

$$\frac{1 \text{ pound N}}{\text{Per } 1{,}000 \text{ ft}^2} \times \frac{100 \text{ pounds 34-0-0}}{34 \text{ pounds of N}} = \frac{3 \text{ Pounds of 34-0-0}}{\text{Per } 1{,}000 \text{ ft}^2}$$

Pretend our P and K are low…

Lawn need is,
1 pound of N, P2O5, and K2O
per 1,000 ft^2

And fertilizer we have is,
10% N   10% P_20_5 10% K_20

$$\frac{1 \text{ pound N}}{\text{Per } 1{,}000 \text{ ft}^2} \times \frac{100 \text{ pounds 10-10-10}}{10 \text{ pounds of N}} = \frac{10 \text{ Pounds of 10-10-10}}{\text{Per } 1{,}000 \text{ ft}^2}$$

This also applies 1 pound of P2O5 and K20

Doing the math…

We applied 10 pounds of 10-10-10

$$10 \text{ pounds product per } 1{,}000 \text{ ft}^2 \times \frac{10 \text{ pounds P205}}{100 \text{ pounds of 10-10-10}} = 1 \text{ pound } P_2O_5 \text{ per } 1{,}000 \text{ ft}^2$$

$$10 \text{ pounds product per } 1{,}000 \text{ ft}^2 \times \frac{10 \text{ pounds } K_20}{100 \text{ pounds of 10-10-10}} = 1 \text{ pound } K_20 \text{ per } 1{,}000 \text{ ft}^2$$

Pretend our K is low, but P is fine…

Lawn need is,
1 pound of N, and 1 pound of K_2O
per 1,000 ft^2

And fertilizers we have are:

10% N	0% P_20_5	0% K_20
0% N	0% P_20_5	50% K_20

$$\frac{\text{1 pound N}}{\text{Per 1,000 ft}^2} \times \frac{\text{100 pounds 10-0-0}}{\text{10 pounds of N}} = \frac{\text{10 Pounds of 10-0-0}}{\text{Per 1,000 ft}^2}$$

$$\frac{\text{1 pound K}_2\text{O}}{\text{Per 1,000 ft}^2} \times \frac{\text{100 pounds 0-0-50}}{\text{50 pounds of K}_2\text{O}} = \frac{\text{2 Pounds of 0-0-50}}{\text{Per 1,000 ft}^2}$$

Which one is better?

Higher concentration fertilizer

Lower concentration fertilizer

What is the cost per pound of nutrient?

What is the release rate?

What is the plant's need?

Liquid fertilizers

Additional Liquid fertilizer question to ask yourself…

What is its density?

Liquid fertilizers

Now have to worry about converting gallons to pounds…

May be on front or back of bottle

26.2 pounds / 2.5 Gallons = 10.48 pounds per gallon

May have to look on Safety Data Sheet (SDS) for density

SECTION 9 – PHYSICAL AND CHEMICAL PROPERTIES

Physical State: Liquid	Odor and Appearance: No offensive odor. Dark brown to black color.
Specific Gravity: 1.165	Vapor Density (air = 1): N/A
Evaporation Rate:	Boiling Point (°C) > 212° F
pH: 5.5 +/- 0.5	Coefficient of Water/Oil Distribution:

Specific gravity of 1 = density of water = 8.354 pounds per gallon

The liquid fertilizer formula

Recommendation		From % nutrient in the bottle		Pounds to apply
Pounds nutrient per area	x	100 pounds product / pounds nutrient	=	Pounds product per area

Pounds to apply		Density		Answer
pounds product per area	x	Gallons Per pound	=	Gallons to apply Per area

Liquid fertilizer, *doing the math…*

UAN

32% N   0% P_2O_5 0% K_2O

Recommendation		#nutrient per 100# product		Pounds to apply
1 pound N Per 1,000 Sq. Ft.	x	$\frac{\text{100 pounds product}}{\text{32 pounds N}}$	=	3.13 pounds product Per 1,000 Sq. Ft.

Pounds to apply		Density		Answer
3.13 pounds Per 1,000 Sq. Ft.	x	$\frac{\text{1 gallon}}{\text{11 lbs. product}}$	=	0.28 Gallons product Per 1,000 Sq. Ft.

Checking a real life's bottle suggestion….

10% N   10% P_2O_5 10% K_2O

Bottle suggestion		Density		Pounds product
Suggests 0.17 gal per 1,000 sq. ft.	x	10.5 pounds / per gallon	=	1.8 pounds product per 1,000 sq. ft.

Pounds to apply		#nutrient per 100# product		Answer
1.8 pounds per 1,000 sq. ft.	x	10 lbs. N / 100 lbs. product	=	0.18 pounds N per 1,000 sq. ft.

$74.99 for 2.5 gallons

Liquid fertilizers also good for…

Starter fertilizers

APP, UAN

Micro-nutrients

G. Higgins and S. Scheufele. September 2016. U Mass Extension.

Boron rate = 0.02 pound per 1,000 ft^2

High pH soils

R. Finneran and M. Wilson. March 2018. Michigan State University Extension

Iron and manganese

Fertilizer questions?

Lime

Lime questions to ask yourself…

What is the RNV basis on the recommendation?

What is the RNV of the limes avaible to you?

What is the cost to apply the right rate?

RNV = Relative Neutralizing Value

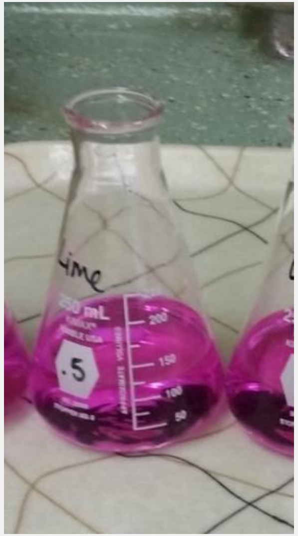
Lime, when do you need it

Soil pH

4.5	5	5.5	6	6.5	7
	Blueberries	Blackberries, Strawberries, Acid loving shrubs	Lawn, Corn, Soybeans, Most vegetables	Alfalfa, Sweet clover	

How do you grade lime?

Purity



Fineness

Kansas State Agronomy Dept.

How do you grade lime?

Purity – calcium carbonate equivalent (CCE)

Type	**Composition**	***CCE if pure***
Calcitic	Calcium carbonate	100
Dolomitic	Ca/Mg carbonate	109
slaked	Calcium hydroxide	135
Burnt or quick	Calcium oxide	179

How do you grade lime?

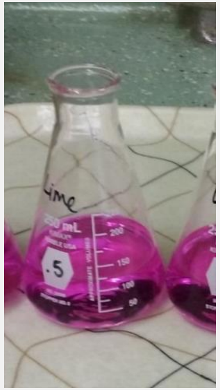
Fineness

Mesh	Inches	Efficiency factor
> 10	79/100	0.33
10 to 40	2/100	0.73
40 to 60	1/100	0.93
< 60	< 1/100	1

Kansas State Agronomy Dept.

How do you grade lime?

CCE x Fineness = Relative Neutralizing Value "RNV"



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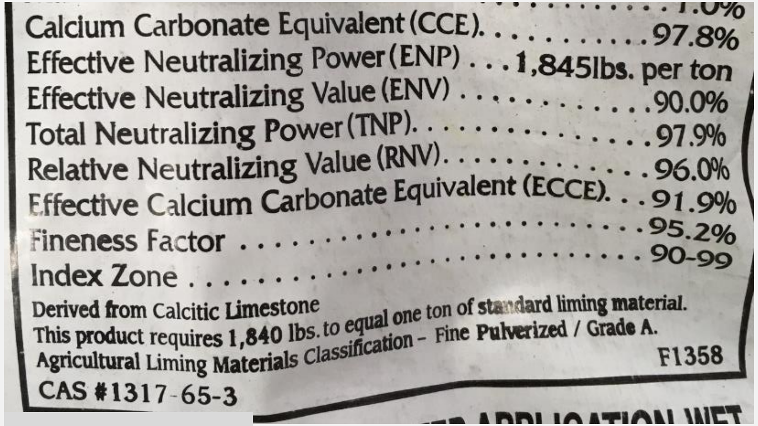

A Windham

Lime math formula

Recommendation		Converts RNV for you		Pounds to apply
Pounds of lime as X% RNV per area	x	%RNV on recommendation / % RNV you will buy	=	Pounds of lime you buy per area

Pounds applied		Cost per pound		Cost to apply
Pounds products RNV per area	x	$ Dollar per pound product	=	$ Dollar per area

Do iterations of different products available to you to find the cost per area

Lime math formula

Recommendation		Converts RNV for you		Pounds to apply
100 Pounds as 65% RNV per 1,000 ft^2	x	$\frac{65}{80}$	=	81 pounds of 80% RNV per 1,000 ft^2
		Pretend you buy 80%RNV lime		

Pounds applied		Cost per pound		Cost to apply
81 pounds of 80% RNV per 1,000 ft^2	x	\$ 0.16 Dollar per pound product	=	\$12.96 per 1,000 ft^2

Do iterations of different products available to you to find the cost per area

Lime math formula

Recommendation

80 Pounds as 100% RNV per 1,000 ft^2

x

Converts RNV for you

$$\frac{100}{75}$$

Pretend you buy 75%RNV lime

=

Pounds to apply

107 pounds of 75% RNV per 1,000 ft^2

Pounds applied

107 pounds of 75% RNV per 1,000 ft^2

x

Cost per pound

$ 0.10 Dollar per pound product

=

Cost to apply

$10.70 per 1,000 ft^2

Do iterations of different products available to you to find the cost per area

What is better?

Calcitic	Dolomitic
Both *start* reacting with soil as water is available	
	Less soluble
	Has magnesium
Price depends on how close you are to a source	

What is better?

Ground lime

Pelletized “Pell” Lime

Check RNV

Check price

If pell is much more expensive than ground,
Ask yourself, do you want to pay the convenience fee
(*more even spread, less dust*)

Liquid Lime

Liquid lime math formula

Recommendation		Converts RNV for you		Pounds to apply
Pounds of lime as X% RNV per area	x	%RNV on recommendation / % RNV you will buy	=	pounds products RNV per area

Pounds to apply		Density		Gallons to apply
pounds products RNV per area	x	Gallons per pound	=	Gallons per area

Do iterations of different products available to you to find the cost per area

One real life on the shelf product

Has an RNV of 70

A density of 14.8 pounds per gallon

Costs $20 per gallon

Suggests 5 gallons per acre

Liquid lime math formula

Recommendation		Converts RNV for you		Pounds to apply
100 Pounds as 65% RNV per 1,000 ft^2	x	$\frac{65}{70}$ *Product is 70% RNV*	=	92 pounds per 1,000 ft^2

Pounds to apply		Density		Gallons to apply
92 pounds per 1,000 ft^2	x	$\frac{\text{1 Gallon}}{\text{14.8 pounds}}$	=	6.2 Gallons per 1,000 ft^2

6.2 Gallons at $20 per gallon is $124 per 1,000 ft^2

Remember the bottle's suggestion was 5 gallons per acre but we really needed 6.2 Gallons per 1,000 ft^2

1 acre inch of water is about 27,000 gallons

1,000 ft^2 x 1 inch of water is about 620 gallons

Liquid Lime math

Guaranteed Analysis

[redacted]

Calcium (Ca)	10%
Calcium Carbonate (CaCO3)	0.24%
Calcium Carbonate Equivalent (CCE)	0.24%
Passing 180 Mesh Sieve	100%
Passing 100 Mesh Sieve	100%
Passing 40 Mesh Sieve	100%
Passing 20 Mesh Sieve	100%
Passing 10 Mesh Sieve	100%
Lime Score	0.216
Moisture Content Does Not Exceed	90%

Derived from Calcium Chloride

Liquid Lime math

Product details

Lime has been used for hundreds of years to “sweeten” or alkalize acidic soils. But nobody likes the drudgery of hauling heavy bags to a spreader, then applying it in a cloud of dust. Say goodbye to all that. With your [redacted] all you need to do is spray it, just like all our other liquid products. *Liming has never been easier!* You can also use [redacted] as a foliar spray to supply calcium for lawns, gardens, farms, and pastures! *Note: item may be labeled "Liquid Calcium" due to state labeling laws.*

$44.99

Add to cart

Size: gallon

Always ask, does the math add up?

Robert Florence
RobertF@utk.edu

Compost example

If we need

1 lbs. of N per 1,000 ft^2

And we have urban compost

~2 - ~0.25 - ~1.5

UC Davis

$$\frac{1 \text{ pound N}}{\text{Per } 1{,}000 \text{ ft}^2} \times \frac{100 \text{ pounds compost}}{2 \text{ pounds N}} = \frac{50 \text{ pounds dry compost}}{\text{per } 1{,}000 \text{ ft}^2}$$

If 10% of the N is available, then one would need 500 pounds

Umass Extension

Compost is good for…

Organic matter

Infiltration

Aeration

Retaining nutrients

Alleviating compaction