

GENERAL CROP MANAGEMENT

TEMPERATURE DEVELOPMENTAL UNITS

There are three methods that are used to determine temperature development units. Two methods, Degree Days (DD) and Heat Units (HU), are used to help in determining insect development while the third method, Growing Degree Days (GDD) is used in determining the stage of plant development.

A brief description of each method and how it is computed is as follows:

1. **Degree Days (DD)** is used to predict the development of insects. It assumes there are 12 hours of low temperature and 12 hours of high temperature in a 24 hour period. The DD is calculated by adding the low and high temperatures, dividing by 2 and subtracting a base temperature at which the insect is active.

$$\text{DD} = \text{Average temperature} - \text{Threshold}$$

Ex: Max. Temp. = 70; Min. temp. = 45; Threshold = 50

$$\frac{70 + 45}{2} - 50 = 7.5 \text{ DD}$$

In this example 7.5 degree days have accumulated.

2. **Growing Degree Days (GDD)** is used to predict physiological maturity in hybrids and is a modification of Degree Days. GDD assumes that some biological activity occurs even if the temperature is above 50°F for part of a day, even if the average temperature is below threshold.

TEMPERATURE DEVELOPMENTAL UNITS (CONT.)

Growing Degree Days (GDD) (cont.)

Ex: Max. temp = 65; Min. temp = 40; Threshold = 50

$$\frac{65 + 50}{2} - 50 = 7.5 \text{ GDD}$$

GDD also assumes that maximum biological activity occurs at 86°F and plants do not grow faster above this temperature.

Ex: Max. temp = 90; Min. temp = 70; Threshold = 50

$$\frac{86 + 70}{2} - 50 = 28 \text{ GDD}$$

3. Cosine Curve Method (CCM)—Heat Units (HU)

This method is used to predict insect development and accounts for the fact that temperatures do not stay the same throughout the 24 hour period, but follow a curve. A cosine curve is fitted to yesterday's minimum and today's maximum and the temperature after each hour is computed. The HU accumulations for a 24 hour period are summed and that gives the number of HU for the day.

ESTIMATING SURFACE RESIDUE COVER

The amount of crop residue left on the soil after a tillage or planting operation is important for erosion control. There are several ways and tools that can be used to measure crop residue. Following is a method that can be used to estimate the percentage of soil surface covered by crop residue after a tillage or planting operation.

1. Divide a 50' rope into 100 equal parts (6" apart) by tying knots or attaching tape at each division. Stretch the rope diagonally across the crop rows at a 45 degree angle.
2. Walk along the rope and count the number of times a piece of crop residue intersects a knot or piece of tape. Be sure to look at the same place on the knot or tape to maintain accuracy.
3. After walking the entire length of rope, total the number of times that crop residue intersects a knot or piece of tape. This is equal to the percentage of soil surface covered with crop residue. Example: if 35 knots or pieces of tape intersected a piece of crop residue, then 35% of the soil surface would be covered with crop residue.
4. Repeat this procedure in either 3 or 5 areas in the field and average the numbers to obtain an average estimate of residue cover in the field. Do not take measurements in turn row areas.

NUTRIENTS REMOVED IN HARVESTED PORTIONS OF CROPS

Crop	Unit of Yield	Nutrient removed per unit of yield	
		P ₂ O ₅	K ₂ O
lb/unit			
Corn			
Feed grain	bushel	0.37	0.27
Silage	ton	3.30	8.00
Soybeans			
Wheat	bushel	0.80	1.40
Wheat			
Grain	bushel	0.63	0.37
Straw	bushel	0.09	0.91
Alfalfa	ton	13.00	50.00

SOIL pH RECOMMENDED FOR VARIOUS CROPS ON VARIOUS SOILS

Crop	Mineral soils with subsoil pH		Organic soils
	> pH 6	< pH 6	
Alfalfa	6.5	6.8	5.3
Other forage legumes	6.0	6.8 ¹	5.3
Corn	6.0	6.5	5.3
Soybeans	6.0	6.5	5.3
Small grains	6.0	6.5	5.3
Other crops	6.0	6.5	5.3

¹ Birdsfoot trefoil should be limed to pH 6.0.

Table 8. Tons of aglime (Effective Neutralizing Power (ENP) of 2000 lbs/ton) needed to raise the soil pH to the desired pH level based on the Shoemaker-McLean-Pratt (SMP) buffer pH and an incorporation depth of 8". For no-till application, the rate should be divided by 2 (soil samples should only be collected to a depth of 4").

Buffer pH*	Desired pH levels				
	Mineral soils			Organic soils	
	6.8	6.5	6.0	Soil pH	5.3
	tons agricultural limestone/acre			— tons/acre —	
6.8	0.9	0.8	0.7	5.2	0.0
6.7	1.6	1.4	1.1	5.1	0.5
6.6	2.2	2.0	1.6	5.0	0.8
6.5	2.9	2.5	2.0	4.9	1.3
6.4	3.6	3.1	2.5	4.8	1.7
6.3	4.2	3.6	3.0	4.7	2.1
6.2	4.9	4.2	3.4	4.6	2.5
6.1	5.6	4.7	3.9	4.5	2.9
6.0	6.2	5.3	4.4	4.4	3.3
5.9	6.9	5.9	4.7		

*Lime test index (LTI), which may be reported in place of buffer pH, is buffer pH times 10.

CRITICAL SOIL TEST LEVELS (CL) FOR VARIOUS AGRONOMIC CROPS

Crop	Critical Soil Test Levels				
	K at CEC ¹				
	P				
	5	10	20	30	
	ppm (lb/acre)		ppm (lb/acre)		
Com	15 (30) ²	88 (175)	100 (200)	125 (250)	150 (300)
Soybean	15 (30)	88 (175)	100 (200)	125 (250)	150 (300)
Wheat	25 (50)	88 (175)	100 (200)	125 (250)	150 (300)
Alfalfa	25 (50)	88 (175)	100 (200)	125 (250)	150 (300)

¹ Critical level for ppm K = $75 + (2.5 \times \text{CEC})$ for all crops

² Values in parenthesis are lb/acre.

Note: A CEC of 15 is used to calculate the K_2O recommendation for calcareous soils (soils with pH equal to or greater than 7.5 and a calcium saturation of 80% or greater) and organic soils (soils with an organic matter content of 20% or greater or having a scooped density of less than 0.8 grams per cubic centimeter).

CROP & SOIL CONDITIONS WHERE SECONDARY & MICRONUTRIENT DEFICIENCIES MAY OCCUR

Micronutrient	Soil	Crop
Boron (B)	Sandy soils or highly weathered soils low in organic matter	Alfalfa and clover
Calcium (Ca)	Very low pH soils	Alfalfa
Copper (Cu)	Acid peats or mucks and black sands	Wheat, oats and corn
Iron (Fe)	High pH, wet poorly aerated soil, cool temperature	Soybeans, navy beans, millet, milo
Magnesium (Mg)	Low pH, high K, sandy soils	Corn
Manganese (Mn)	High pH, high organic matter	Soybeans, navy beans
Molybdenum (Mo)	Acid prairie soils	Soybeans and Alfalfa
Sulfur (S)	Low organic matter, sandy, cold, wet soils	Alfalfa
Zinc (Zn)	Peats, mucks, and mineral soils with pH >6.5, high P, heavily manured	Soybeans and Alfalfa

POSSIBLE CAUSES FOR NUTRIENT ELEMENT LEVELS
BELOW OR ABOVE THE SUFFICIENCY RANGE

Ohio Plant Analysis Program

Below Sufficiency
Range

Above Sufficiency
Range

Nitrogen (N)

- | | |
|-----------------|--------------------------------------|
| 1) Inadequate N | 1) Excessive application of nitrogen |
| 2) Low soil P | 2) Shortage of another element |

Phosphorus (P)

- | | |
|------------------|------------------------------------|
| 1) Low soil P | 1) High soil P |
| 2) Inadequate P | 2) Excessive phosphate application |
| 3) Poor Drainage | |
| 4) Low soil pH | |

Potassium (K)

- | | |
|------------------------|----------------------------|
| 1) Low soil K | 1) High soil K level |
| 2) Inadequate K | 2) Excessive K application |
| 3) Heavy N application | 3) Ca or Mg deficiency |

Calcium (Ca)

- | | |
|---------------------------------------|----------------------------|
| 1) Low soil pH | 1) Old plant tissue |
| 2) Low soil Ca | 2) Dead or diseased tissue |
| 3) High soil K or heavy K application | |

Magnesium (Mg)

- | | |
|---------------------------------------|----------------------------|
| 1) Low soil pH | 1) Old plant tissue |
| 2) Low soil Mg | 2) Dead or diseased tissue |
| 3) High soil K or heavy K application | |

Ohio Plant Analysis Program (cont.)

Below Sufficiency
Range

Above Sufficiency
Range

Manganese (Mn)

- | | |
|---|---|
| 1) Neutral or alkaline soils, peats & mucks | 1) Low soil pH
2) Heavy application of P and/or N on acid, low organic matter soils
3) Soil or dust contamination |
|---|---|

Iron (Fe)

- | | |
|-----------------|---|
| 1) High soil pH | 1) Soil or dust contamination
2) Zinc deficiency |
|-----------------|---|

Boron (B)

- | | |
|---|----------------------------------|
| 1) Alkaline, sandy, or low organic matter soils | 1) Improper application of boron |
|---|----------------------------------|

Copper (Cu)

- | | |
|---------------------------------|--|
| 1) Peats, mucks or upland light | 1) Contamination from pesticide sprays or contact with brass equipment |
|---------------------------------|--|

Zinc (Zn)

- | | |
|--|---|
| 1) Sands, exposed subsoils, soils high in pH & available P, mucks & some peats | 1) Contamination from contact with brass or galvanized equipment
2) Old, dead or diseased tissue |
|--|---|

Molybdenum (Mo)

- | | |
|-------------------------|--|
| 1) Acid soils, pH < 5.5 | 1) Potassium deficiency
2) High soil pH |
|-------------------------|--|

LENGTH OF ROW EQUAL TO $1/1000^{\text{th}}$ ACRE

Measuring the number of plants in an acre is done sometime during the growing season. A simple method to use is by counting the number of plants in $1/1000^{\text{th}}$ of an acre. This is done by measuring along the row the distance needed to equal $1/1000^{\text{th}}$ of an acre (based on row width). The number of plants are counted in this measured distance. After doing this in at 3 separate sections of the field, the average of these samples is calculated and multiplied by 1000. This represents the number of plants per acre.

Row width inches	Length of single row to equal $1/1000^{\text{th}}$ of an acre	
	Feet	inches
6	87	1
7	74	8
8	65	4
10	52	3
15	34	10
20	26	2
28	18	8
30	17	5
32	16	4
36	14	6
38	13	9
40	13	1

APPROXIMATE FERTILIZER NUTRIENT VALUES OF ANIMAL MANURE AT TIME APPLIED TO LAND - SOLID HANDLING SYSTEMS^a

Nutrient Content						
Type of Livestock	Bedding vs No Bedding	Dry Matter (%)	Total N ^b	NH ₄ ^c	P ₂ O ₅ ^d (lb/ton)	K ₂ O ^e
Swine	Without Bedding	18	10	6	9	8
	With Bedding	18	8	5	7	7
Beef	Without Bedding ^f	52	21	7	14	23
Cattle	With Bedding	50	21	8	18	26
Dairy	Without Bedding	18	9	4	4	10
Cattle	With Bedding	21	9	5	4	10
Sheep	Without Bedding	28	18	5	11	26
	With Bedding	28	14	5	9	25
Poultry	Without Litter	45	33	26	48	34
	With Litter	75	56	36	45	34
	Deep Pit (compost)	76	68	44	64	45
Turkey	Without Litter	22	27	17	20	17
	With Litter	29	20	13	16	13
Horses	With Bedding	46	14	4	4	14

a Manure spreader capacity: 1 bu = 40-60 lb

b Ammonium N plus organic N, which is slow releasing.

c Ammonium N, which is available to the plant during the growing season.

d To convert to elemental P, multiply by 0.44.

e To convert to elemental K, multiply by 0.83

f Open dirt lot.

Refer to OSU Extension Bulletin 604, Ohio Livestock Manure and Wastewater Management Guide

APPROXIMATE FERTILIZER NUTRIENT VALUES OF ANIMAL MANURE AT TIME APPLIED TO LAND - LIQUID HANDLING SYSTEMS^a

Type of Livestock	Bedding vs No Bedding	Dry Matter	Total N ^b	Nutrient Content		
				NH ₄ ^c	P ₂ O ₅ ^d	K ₂ O ^e
		(%)		(lb/1,000 gal)		
Swine	Liquid pit	4	36	26	27	22
	Lagoon	1	4	3	2	4
Beef	Liquid pit ^f	11	40	24	27	34
Cattle	Lagoon	1	4	2	9	5
Dairy	Without Bedding	8	24	12	18	29
Cattle	With Bedding	1	4	2.5	4	5
Veal calf	Without Bedding	3	24	19	25	51
Poultry	Without Litter	13	80	64	36	96

^a Application conversion factors: 1,000 gal = 4 tons; 27,154 gal = 1 acre-inch

^b Ammonium N plus organic N, which is slow releasing.

^c Ammonium N, which is available to the plant during the growing season.

^d To convert to elemental P, multiply by 0.44.

^e To convert to elemental K, multiply by 0.83

^f Includes feedlot runoff water and is sized as follows: single cell lagoon - 2 cu ft/lb animal wt; two-cell lagoon - cell 1, 1-2 cu ft/lb animal wt and cell 2, 1 cu ft/lb animal wt.

Refer to OSU Extension Bulletin 604, Ohio Livestock Manure and Wastewater Management Guide

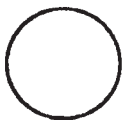
USING THE KERNEL MILKLINE AS A GUIDE IN SILAGE HARVEST

Observing the development of the corn kernel milkline can provide a guide as to when corn is at the proper dry matter content for ensiling. Ohio research indicates variability in the relationship between the kernel milkline and whole plant DM content. Hybrid, planting date, and growing season can affect the relationship between kernel milkline position and whole plant DM content. The appearance of the milkline in the upper 1/4 of the kernel generally indicates that the crop is very near the optimal time to harvest. A sample should be taken at this time and DM content determined with a commercial forage moisture tester or microwave oven.

When an ear of corn is broken in half, the tip half (shown below) shows the interface between the liquid and solid portion of the kernel. The arrows point to the milkline boundary between the liquid endosperm (milk) and the solid endosperm (starch).



AREA & VOLUME CALCULATIONS



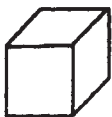
Area of a circle =
radius squared X 3.1416
or diameter squared X 0.7854



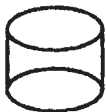
Area of a rectangle or square =
length X width



Area of a triangle = base X height
divided by 2



Volume of a cube or rectangular
box = length X width x height



Volume of a cylinder = radius x
3.1416 X length of cylinder



Volume of a cone = radius
squared x 1.0472 X height

CONVERSION FACTORS

Acres	X 0.405	= Hectares
Acres	X 43560	= Sq Feet
Bushels	X 1.244	= Cubic feet
Bushels	X 4	= Pecks
CaCO ₃	X 0.40	= Calcium(Ca)
CaCO ₃	X 0.84	= MgCO ₃
Calcium (Ca)	X 2.50	= CaCO ₃
Centimeters	X 0.3937	= Inches
Centimeters	X 0.01	= Meters
Centimeters	X 10	= Millimeters
Cord(4'x4'x8')	X 8	= Cord feet
Cubic feet	X 1,728	= Cubic inches
Cubic feet	X 0.03704	= Cubic yards
Cubic feet	X 7.4805	= Gallons
Cubic feet	X 0.84	= Bushels
Cubic inches	X 16.39	= Cubic Centimeters
Cubic meters	X 35.31	= Cubic feet
Degree Celsius	(+17.98)x1.8	= Fahrenheit
Fahrenheit	(-32)x0.5555	= Celsius
Feet	X 30.48	= Centimeters
Feet	X 12	= Inches
Feet	X 0.3048	= Meters
Feet	X 0.33333	= Yards
Ft / minute	X 0.01667	= Ft / second
Ft / minute	X 0.01136	= Miles / hour
Fl ounce	X 1.805	= Cubic inches
Gallons	X 269	= Cubic in. (dry)
Gallons	X 231	= Cubic in. (liq)
Gallons	X 3,785	= Cubic Centimeter
Gallons	X 0.1337	= Cubic feet
Gallons	X 3.785	= Liters
Gallons	X 128	= Ounces (liquid)
Gallons	X 8	= Pints (liquid)
Gallons	X 4	= Quarts (liquid)
Gallons of water	X 8.3453	= Pounds water
Grams	X 0.001	= Kilograms

CONVERSION FACTORS (cont.)

Grams	X 1,000	= Milligrams
Grams	X 0.0353	= Ounces
Grams per liter	X 1,000	= Parts / million
Hectares	X 2.471	= Acres
Inches	X 2.54	= Centimeters
Kilograms (kg)	X 1000	= grams (g)
Kilograms	X 2.205	= Pounds
Kg/hectare	X 0.8929	= Pounds/acre
Kilometers	X 3,281	= Feet
Kilometers	X 1,000	= Meters
Kilometers	X 0.6214	= Miles
Knot	X 6,086	= Feet
K ₂ O	X 0.83	= K (elemental)
Liters	X 1,000	= Milliliters
Liters	X 1,000	= Cubic Centimeters
Liters	X 0.0353	= Cubic feet
Liters	X 0.2642	= Gallons
Magnesium (Mg)	X 3.48	= MgCO ₃
Meters	X 100	= Centimeters
Meters	X 39.37	= Inches
Meters	X 0.001	= Kilometers
Meters	X 1,000	= Millimeters
Meters	X 1.094	= Yards
MgCO ₃	X 0.29	= Magnesium(Mg)
MgCO ₃	X 1.18	= CaCO ₃
Miles	X 5,280	= Feet
Miles	X 1.6909	= Kilometers
Miles per hour	X 88	= Feet / minute
Miles per hour	X 1.467	= Feet / second
Miles per minute	X 88	= Feet / second
Milliter	X 0.034	= Fluid ounces
Ounces (dry)	X 28.349	= Grams
Ounces (liquid)	X 0.00781	= Gallons
Ounces (liquid)	X 29.573	= Cubic centimeters
Ounces (liquid)	X 0.03125	= Quarts (liquid)
P ₂ O ₅	X 0.44	= P (elemental)

CONVERSION FACTORS (cont.)

P (elemental)	X 2.292	= P_2O_5
Parts / million	X 2	= lbs/acre
Parts / million	X 0.001	= Grams / liter
Parts / million	X 0.0001	= Percent
Parts / million	X 1	= Milligram/Kg
Parts / million	X 1	= Milligrams/liter
Pecks	X 0.25	= Bushels
Pints (dry)	X 33.6003	= Cubic inches
Pints (dry)	X 0.5	= Quarts (dry)
Pints (liquid)	X 28.875	= Cubic inches
Pints (liquid)	X 0.125	= Gallons
Pints (liquid)	X 0.4732	= Liters
Pints (liquid)	X 16	= Ounces (liquid)
Pints (liquid)	X 0.5	= Quarts (liquid)
Potash (K_2O)	X 0.83	= Potassium (K)
Potassium (K)	X 1.20	= Potash (K_2O)
Pounds	X 453.592	= Grams
Pounds	X 16	= Ounces
Pounds	X 0.45359	= Kilograms (Kg)
Pounds water	X 0.01602	= Cubic feet
Pounds water	X 0.1198	= Gallons
Pounds / acre	X 1.12	= Kg / hectare
Quarts	X 946	= Milliliters
Quarts (dry)	X 67.20	= Cubic inches
Quarts (liquid)	X 0.9463	= Liters
Quarts (liquid)	X 32	= Ounces (liquid)
Rods	X 16.5	= Feet
Square feet	X 0.000024	= Acres
Square meters	X 0.0001	= Hectares (ha)
Square miles	X 640	= Acres
Ton	X 907.1849	= Kilograms
Ton (long)	X 2,240	= Pounds
Ton (short)	X 2,000	= Pounds
U.S. dry quart	X 1.101	= Liters
U.S. gallon	X 3.785	= Liters