Acid Soil Worksheet

U.S. Measurements

Name _____

Plot or Field _____

Date of Test _____

Sample Depth 6 inches All numbers on this worksheet assume a six inch sample depth

TCEC_____ **TEC:** If CEC is below 10 it is a "light soil." Over 10 is "heavy soil."

pH _____ **pH:** If pH is 7.0 to 7.6, go to the Excess Cations Worksheet. If pH exceeds 7.6, you may have calcareous soil.

Organic Matter % _____ **OM:** Target over 7% in cool climates. South of the Mason-Dixon Line target over 4%. Assume an approximate release of 15–25 lb nitrogen per 1% OM. Varies with temperature, moisture and soil air supply. N = 0.22 x NO_3

Element Level	Actual	Calculating Target Level Pounds per acre	Target Pounds per acre	Deficit Pounds per acre
Sulfur **S**	ppm lb/ac	**S = ½ Mg (Target Level)** until there are no cation excesses; then **you *may* Target S=⅓ K**		
Phosphorus **P**	P_2O_5 P =	**P = K (Target Level)** Calculate using actual P, not phosphate. P = 0.44 x P_2O_5		
Calcium **Ca**	lb/ac	**TCEC x 400 x 0.68 = Target Level**	Minimum target 1,900 lb/ac	
Magnesium **Mg**	lb/ac	**TCEC x 240 x 0.12 = Target Level**		
Potassium **K**	lb/ac	**K is proportional to TCEC: see chart**		
Sodium **Na**	lb/ac	**TCEC x 460 x 0.02 = Target Level** Be certain of good water quality before adding sodium	Do not exceed 160 pounds	
Boron **B**	ppm lb/ac	**B = 2 lb/ac if CEC below 10** **= 4 lb/ac if CEC above 10**	Do not exceed 4 pounds	
Iron **Fe**	ppm lb/ac	**Fe = 100 lb/ac if CEC below 10** **= 150 lb/ac if CEC above 10**		
Manganese **Mn**	ppm lb/ac	**Mn = 55 lb/ac if CEC below 10** **= 100 lb/ac if CEC above 10**		
Copper **Cu**	ppm lb/ac	**Cu = ½ Zn (Target Level)**		
Zinc **Zn**	ppm lb/ac	**Zn = 1/10 P (Target Level)**		

Potassium Target Levels

TCEC	Pounds	TCEC	Pounds	TCEC	Pounds
		16	390	28	493
		17	400	29	500
		18	410	30	507
7	255	19	420	31	511
8	270	20	435	32	515
9	290	21	443	33	519
10	310	22	451	34	523
11	320	23	459	35	527
12	335	24	463	36	531
13	350	25	475	37	535
14	365	26	481	38	539
15	380	27	487	39	543

If TCEC is lower than 7, use value for 7. If it is over 39, use value for 39.

	One acre, six inches deep weighs	One hectare, 180 mm deep weighs
1 meq Calcium	**400 lb**	**400 kg**
1 meq Magnesium	**240 lb**	**240 kg**
1 meq Potassium	**780 lb**	**780 kg**
1 meq Sodium	**460 lb**	**460 kg**

1 ppm = 1mg/kg = 2 pounds/acre = 2.24 kg/hectare

Date of Issue: 10/22/2012

Acid Soil Worksheet, page 2

	Deficit From other side of worksheet	**Application Limit** Per acre/year	**Quantity and Material to Add**	**S**	**Mg**	**Ca**
Sulfur **S**		110 lb 90% Ag S				
Phosphorus **P**		175 lb/ac elemental P				
Calcium **Ca**						
Magnesium **Mg**		No more than 10% of target magnesium per year				
Potassium **K**		200 lb/acre elemental K				
Sodium **Na**						
Boron **B**		2 lb/acre elemental B				
Iron **Fe**						
Manganese **Mn**						
Copper **Cu**		No more than 7 lb elemental Cu				
Zinc **Zn**		No more than 14 lb elemental Zn				

	N	**P**	**K**	**S**	**Ca**	**Mg**
Fish Bone	4	8.8		.06	19.0	.03
Fish Meal	10	2		0.6	2.3	.03
Crab Shell	3	1.5	.025	.02	23.0	1.3
Blood Meal	13	0.5				
Feather Meal	12	0.0	0.35	0.4	0.6	
Bone Meal****	3	13.0		2.5	12.0	0.3
Oilseed Meal	6	1.5	1.0			
Copra Meal	4	1	0.7			
Kelp Meal	1	0.3	2.5	2	2	0.7
Ag Lime					32-39	2
Dolomite					22	13
Gypsum				17	20.5	
Oyster Shell					36	0.03
Magnesium Oxide						50
Montana Hard Rock Phos**		1.3			29	
Calphos		8.8			20	
Monoammonium Phosphate		23 (Plus 12% N as NH_3)				
K-Mag			18.2	22		11
Langbeinite			15.6	23		12
Greensand***		.05	6	1.3	1.5-3.0	2-4
Ag Sulphur				90		

Sea Salt	35%	Sodium (Na)
Borax	10%	Boron (B)
Iron Sulfate	18% S	30% Fe
Manganese sulfate	19% S	32% Mn
Copper Sulfate	12.5% S	25% Cu
Zinc Sulfate*	17% S	35% Zn
Potassium Sulfate	17% S	42% K
Magnesium Sulfate	13% S	10% Mg

* Zinc sulfate picks up moisture from the air; store in airtight container.

** Hard Rock Phosphate is 1.5% available P and contains around 27% insoluble phosphate.

*** Greensand contains 9% Fe, 50% Si and many trace elements. More than half its potassium content is insoluble.

**** Bonemeal contains 5.7% sodium.

Date of Issue: 10/22/2012

Excess Cations Worksheet

U.S. Measurements

Name _____

Plot or Field _____

Date of Test _____

Sample Depth 6 inches All numbers on this worksheet assume a six inch sample depth

TCEC_____ The Mehlich 3 extraction overstates TCEC when free lime is present and should not be used if *the soil reacts when doing the Fizz Test*

pH _____ This worksheet is for M3 audits on non-calcareous soils with a pH of above 7.0. If pH is over 7.6, do a Fizz Test. High pH can be caused by high levels of calcium, magnesium and/or potassium and/or sodium.

Organic Matter % _____ Organic matter levels exceeding 5% are extremely helpful. From normal soil organic matter decomposition, assume approximate release of N = 15–25 lb N per 1% OM. Varies with temperature, moisture and soil air supply. N = 0.22 x NO_3

Element Level	Actual	Calculating Target Level Pounds per acre	Target Pounds per acre	Deficit Pounds per acre
Sulfur **S**	ppm lb/ac	**S = ½ Mg (Target Level)** until cation excesses eliminated; then switch to the Acid Soil Worksheet		
Phosphorus **P**	P_2O_5 P =	**P = K (Target Level)** Calculate using actual P, not phosphate. P = 0.44 x P_2O_5		
Calcium **Ca**	lb/ac	**TCEC x 400 x 0.68 = Target Level**		
Magnesium **Mg**	lb/ac	**TCEC x 240 x 0.12 = Target Level** If deficit less than half of Target Level, do not add Mg		
Potassium **K**	lb/ac	**K is proportional to TCEC: see chart**		
Sodium **Na**	lb/ac	**TCEC x 460 x 0.01 = Target Level** Be certain of good water quality before adding sodium		
Boron **B**	ppm lb/ac	**B = 2 lb/ac if CEC below 10** **= 4 lb/ac if CEC above 10**	Do not exceed 4 pounds	
Iron **Fe**	ppm lb/ac	**Fe = 100 lb/ac if CEC below 10** **= 150 lb/ac if CEC above 10**		
Manganese **Mn**	ppm lb/ac	**Mn = 55 lb/ac if CEC below 10** **= 100 lb/ac if CEC above 10**		
Copper **Cu**	ppm lb/ac	**Cu = ½ Zn (Target Level)**		
Zinc **Zn**	ppm lb/ac	**Zn = 1/10 P (Target Level)**		

Potassium Target Levels

TCEC	Pounds	TCEC	Pounds	TCEC	Pounds
		16	390	28	493
		17	400	29	500
		18	410	30	507
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8	270	20	435	32	515
9	290	21	443	33	519
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12	335	24	463	36	531
13	350	25	475	37	535
14	365	26	481	38	539
15	380	27	487	39	543

If TCEC is lower than 7, use value for 7. If it is over 39, use value for 39.

	One acre, six inches deep weighs	One hectare, 180 mm deep weighs
1 meq Calcium	**400 lb**	**400 kg**
1 meq Magnesium	**240 lb**	**240 kg**
1 meq Potassium	**780 lb**	**780 kg**
1 meq Sodium	**460 lb**	**460 kg**

1 ppm = 1mg/kg = 2 pounds/acre = 2.24 kg/hectare

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Excess Cations Worksheet, page 2

	Deficit From other side of worksheet	**Application Limit** Per acre/year	**Quantity and Material to Add**	**S**	**Mg**	**Ca**
Sulfur **S**		110 lb Ag Sulfur	Reduce excess calcium with Ag Sulfur			
Phosphorus **P**		175 lb/ac elemental P	Use Soft Rock Phosphate if you are not wiling to use Monoammonium phosphate.			
Calcium **Ca**		If below 68% calcium saturation use ag lime sufficient to 68%	If excess Mg, K or Na, use gypsum to satisfy any sulfur deficit. If excess Ca, do not use gypsum, use ag sulfur.			
Magnesium **Mg**		No more than 10% of target magnesium per year				
Potassium **K**		100 lb/ac elemental K				
Sodium **Na**						
Boron **B**		2 lb/ac elemental B				
Iron **Fe**						
Manganese **Mn**						
Copper **Cu**		No more than 7 lb elemental Cu				
Zinc **Zn**		No more than 14 lb elemental Zn				

	N	**P**	**K**	**S**	**Ca**	**Mg**
Fish Bone	4	8.8		.06	19.0	.03
Fish Meal	10	2		0.6	2.3	.03
Crab Shell	3	1.5	.025	.02	23.0	1.3
Blood Meal	13	0.5				
Feather Meal	12	0.0	0.35	0.4	0.6	
Bone Meal****	3	13.0		2.5	12.0	0.3
Oilseed Meal	6	1.5	1.0			
Copra Meal	4	1	0.7			
Kelp Meal	1	0.3	2.5	2	2	0.7
Ag Lime					32-39	2
Dolomite					22	13
Gypsum				17	20.5	
Oyster Shell					36	0.03
Magnesium Oxide						50
Montana Hard Rock Phos**		1.3			29	
Calphos		8.8			20	
Monoammonium Phosphate		23 (Plus 12% N as NH_3)				
K-Mag			18.2	22		11
Langbeinite			15.6	23		12
Greensand***		.05	6	1.3	1.5-3.0	2-4
Ag Sulphur				90		

Sea Salt	35%	Sodium (Na)
Borax	10%	Boron (B)
Iron Sulfate	18% S	30% Fe
Manganese sulfate	19% S	32% Mn
Copper Sulfate	12.5% S	25% Cu
Zinc Sulfate*	17% S	35% Zn
Potassium Sulfate	17% S	42% K
Magnesium Sulfate	13% S	10% Mg

* Zinc sulfate picks up moisture from the air; store in airtight container.

** Hard Rock Phosphate is 1.5% available P and contains around 27% insoluble phosphate.

*** Greensand contains 9% Fe, 50% Si and many trace elements. More than half its potassium content is insoluble.

**** Bonemeal contains 5.7% sodium.

Date of Issue: 10/22/2012

Calcareous Soil Worksheet

U.S. Measurements

Name _____

Plot or Field _____

Date of Test _____

Sample Depth 6 inches All numbers on this worksheet assume a six inch sample depth

pH _____ This worksheet is for soils that naturally hold free calcium (usually pH over 7.5) and those artifically created "Tiedjens" style (usually pH 7.1 or 7.2). Check that you actually have calcareous soil by doing a Fizz Test. Then get the proper soil test.

TCEC _____ Use the results from an elevated pH ammonium acetate extraction to determine TCEC. If necessary, calculate TCEC yourself using the formula on the bottom of this worksheet. Do not use levels discovered by a Mehlich 3 extraction or an ammonium acetate at pH 7.0 extraction to determine TCEC on calcareous or "over" limed soils.

Organic Matter % _____ From normal soil organic matter decomposition, assume approximate release of N = 15–25 lb N per 1% OM. Varies with temperature, moisture and soil air supply. N = 0.22 x NO_3

Element	Actual Level	Calculating Target Level Pounds per acre	Target Pounds per acre	Deficit Pounds per acre
Sulfur **S**	ppm lb/ac	**S minimum = Mg (Target Level)**		
Phosphorus **P**	ppm lb/ac	**P = K (Target Level)** Calculate using actual P, not phosphate. P = 0.44 x P_2O_5		
Calcium **Ca**	ppm lb/ac	**TCEC x 400 x 0.85 = Target Level**		
Magnesium **Mg**	ppm lb/ac	**TCEC x 240 x 0.05 = Target Level**		
Potassium **K**	ppm lb/ac	**K is proportional to TCEC: see chart**		
Sodium **Na**	ppm lb/ac	**TCEC x 460 x 0.01 = Target Level** Be certain of good water quality before adding sodium		
Boron **B**	ppm lb/ac	**B = 2 lb/ac if CEC below 10** **= 4 lb/ac if CEC above 10**	Do not exceed 4 pounds	
Iron **Fe**	ppm lb/ac	**Fe = 100 lb/ac if CEC below 10** **= 150 lb/ac if CEC above 10**		
Manganese **Mn**	ppm lb/ac	**Mn = 55 lb/ac if CEC below 10** **= 100 lb/ac if CEC above 10**		
Copper **Cu**	ppm lb/ac	**Cu = ½ Zn (Target Level)**		
Zinc **Zn**	ppm lb/ac	**Zn = 1/10 P (Target Level)**		

Potassium Target Levels

TCEC	Pounds	TCEC	Pounds	TCEC	Pounds
		16	308	28	394
		17	316	29	397
		18	324	30	400
7	201	19	332	31	403
8	212	20	340	32	406
9	225	21	348	33	409
10	240	22	356	34	412
11	252	23	364	35	415
12	264	24	372	36	418
13	276	25	380	37	420
14	288	26	384	38	422
15	300	27	388	39	424

If TCEC is lower than 7, use value for 7. If it is over 39, use value for 39.

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	One acre, six inches deep weighs	One hectare, 180 mm deep weighs
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1 ppm = 1mg/kg = 2 pounds/acre = 2.24 kg/hectare

Calculating TCEC:

$$\frac{\frac{\text{lb/ac calcium}}{400} + \frac{\text{lb/ac Mg}}{240} + \frac{\text{lb/ac K}}{780} + \frac{\text{lb/ac Na}}{460}}{(100 - \text{percent } H^+ - \text{other bases}^*)} \times 100 = \text{TCEC}$$

*In the case of calcareous soil, there is no H^+ and other bases usually are about 4%.

Calcareous Soil Worksheet, page 2

	Deficit From other side of worksheet	**Application Limit** Per acre/year	**Quantity and Material to Add**	**S**	**Mg**	**Ca**
Sulfur **S**			If no other sulphates needed, use gypsum to reach minimum target level.			
Phosphorus **P**		175 lb/ac elemental P	Use Soft Rock Phosphate if you are not willing to use Monoammonium phosphate.			
Calcium **Ca**		Gypsum: 1 ton per acre	Use gypsum; it is okay to exceed minimum sulfur target.			
Magnesium **Mg**		No more than 20% of target magnesium per year	Use K-Mag or Langbeinite even if this puts K or S into excess.			
Potassium **K**		100 lb/ac elemetal K	Use potassium sulphate. If this puts sulfur over the target level, go ahead anyway.			
Sodium **Na**						
Boron **B**		2 lb/ac elemental B				
Iron **Fe**		Foliar feeding only				
Manganese **Mn**		No more than 10 lb elemental Mn				
Copper **Cu**		No more than 5 lb elemental Cu				
Zinc **Zn**		No more than 10 lb elemental Zn				

	N	**P**	**K**	**S**	**Ca**	**Mg**
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Fish Meal	10	2		0.6	2.3	.03
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Copra Meal	4	1	0.7			
Kelp Meal	1	0.3	2.5	2	2	0.7
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