Steps to Productive Soil

False witness has been borne in condemning land which, if properly worked, would yield rich returns. The narrow plans, the little strength put forth, the little study as to the best methods, call loudly for reform. The people need to learn that patient labor will do wonders. There is much mourning over unproductive soil, when if men would read the Old Testament Scriptures they would see that the Lord knew much better than they in regard to the proper treatment of land. After being cultivated for several years, and giving her treasure to the possession of man, portions of the land should be allowed to rest, and then the crops should be changed. {FE 323.1}

We should work the soil cheerfully, hopefully, gratefully, believing that the earth holds in her bosom rich stores for the faithful worker to garner, stores richer than gold or silver. ..... With proper, intelligent cultivation the earth will yield its treasures for the benefit of man. The mountains and hills are changing; the earth is waxing old like a garment; but the blessing of God, which spreads a table for His people in the wilderness, will never cease. {6T 178.2}

Steps to Productive Soil

- Build Organic Matter
- Balance Nutrients
- Proper Tillage
- Manage Nitrogen
- Grow Green Manure
- Rest the Land
- Prayer

Organic Matter

- Improves soil structure
- Feeds Microbes
- Source of Plant Nutrients
- Breaks Down Into Stable Humus
- Improves nutrient and water holding capacity

Sources of Organic Matter

- Crop residues – always recycle; till in or compost.
- Green manures – grow organic matter right in place.
- Weeds – free; till in or compost before they seed.
- Compost – builds organic matter while feeding the crop; add at planting time.
- Manure – best if composted or well rotted.
- Hay – can have weed seeds; use for compost, mulch or sheet composting.

Sources of Organic Matter

- Straw – good mulch; till in for next year, can be composted with high nitrogen materials.
- Leaves – use as mulch, or composted with high nitrogen materials or sheet composted.
- Leafmold – low pH, low in nitrogen; use in conjunction with high nitrogen materials.
- Kitchen scraps – best composted; or can be dug into garden rows during off season.
- Food processing waste – peanut hulls, sugar cane waste, soybean pulp, rice hulls, etc.

Organic Materials

- **High** C/N ratio = **low** nitrogen content (straw-like, dry, woody)

Straw	80:1
Sawdust	400:1
Leaves	50:1

Organic Materials

- **Low** C/N ratio = **high** nitrogen content (fresh, green, tender)

Clover	15:1
Manure	10-20:1
Grass clippings	15-20:1

Common Mistakes

- Adding large amounts of low-nitrogen organic matter to the soil without balancing it with high-nitrogen materials
- Adding large amounts of rough organic matter just before planting.

  -Ties up nutrients

  -Interferes with seedbed preparation and planting

General Amendment Application

For a soil initially of low fertility:

	Amount per 1 acre (40,000 sq. ft.)	**Amount per 1,000 sq. ft.**	**Amount per 100 sq. ft.**
Manure or compost	40 tons	1 ton	200 lbs.
Colloidal phosphate	2 tons	100 lbs.	10 lbs.
Greensand	2 tons	100 lbs.	10 lbs.

For a soil initially of medium fertility:

	Amount per 1 acre (40,000 sq. ft.)	**Amount per 1,000 sq. ft.**	**Amount per 100 sq. ft.**
Manure or compost	20 tons	½ ton	100 lbs.
Colloidal phosphate	1 ½ tons	75 lbs.	7.5 lbs.
Greensand	1 ½ tons	75 lbs.	7.5 lbs.

For an initially fertile soil:

	Amount per 1 acre (40,000 sq. ft.)	**Amount per 1,000 sq. ft.**	**Amount per 100 sq. ft.**
Manure or compost	10 tons	500 lbs.	50 lbs.
Colloidal phosphate	1 tons	50 lbs.	5 lbs.
Greensand	1 tons	50 lbs.	5 lbs.

Maintenance Application

	Amount per 1 acre	**Amount per 1,000 sq. ft.**	**Amount per 100 sq. ft.**
Manure or compost (applied every other year)	10 - 20 tons	500 – 1,000 lbs.	50 - 100 lbs.
Colloidal phosphate * (applied in years 2, 6, 10 and so on)	½ ton	25 lbs.	2.5 lbs.
Greensand * (applied in years 2, 6, 10 and so on)	½ ton	25 lbs.	2.5 lbs.
Limestone	As required	As required	As required

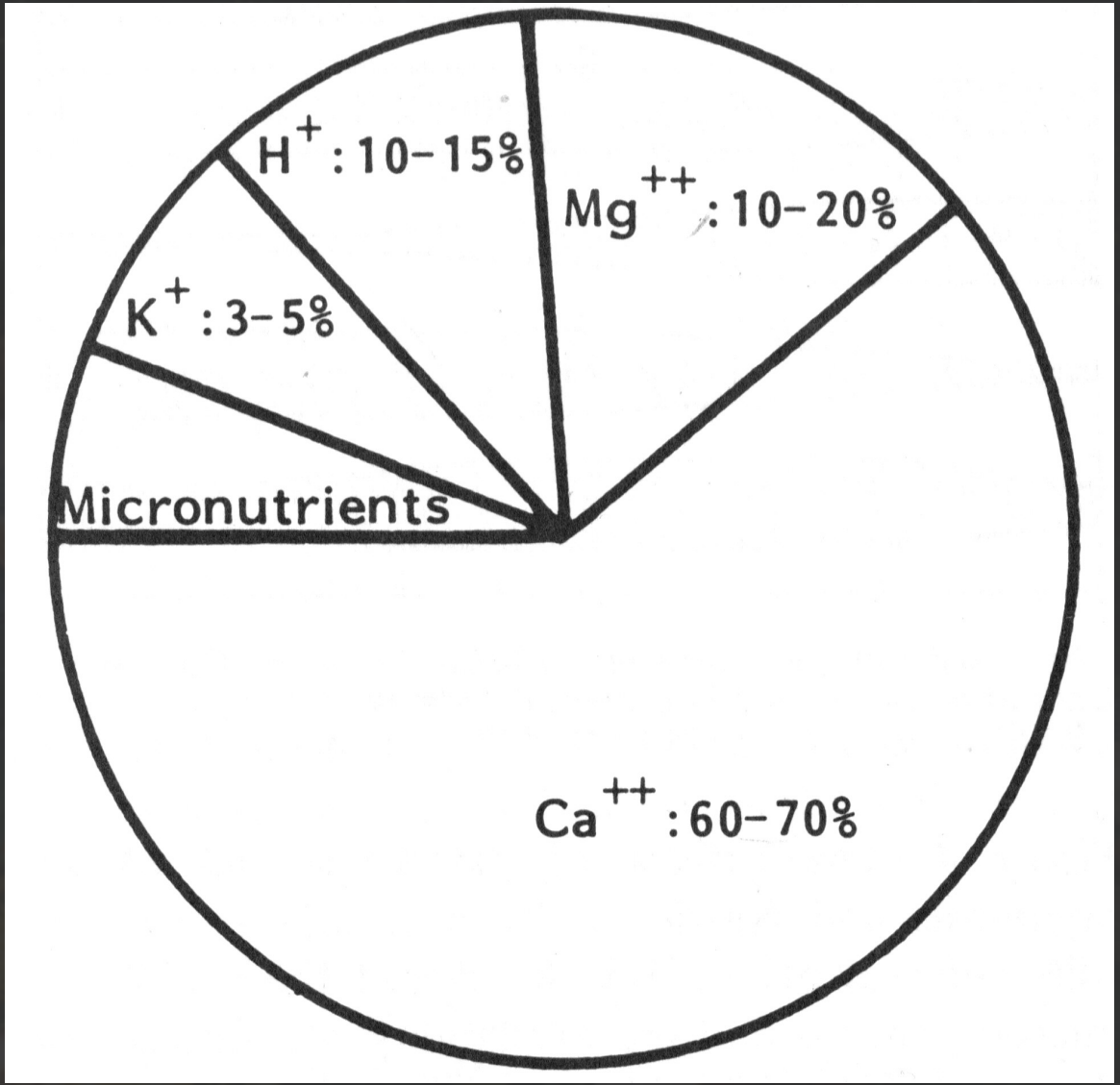
*** Not necessary if a soil test indicates P, K, and trace minerals are adequate.**

Balance Nutrients

- Apply amendments based On CEC Soil Test.

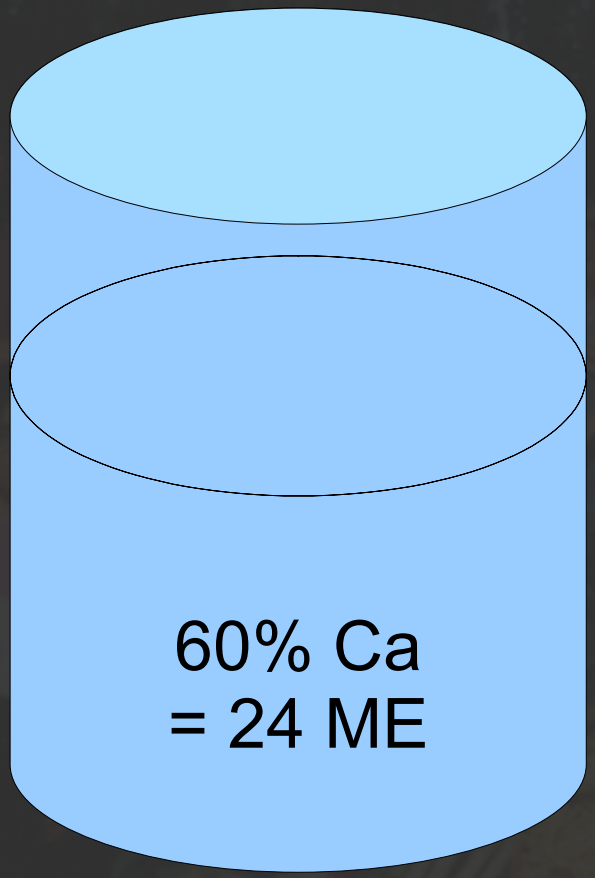
Cation Exchange Capacity

The CEC is like the size of the soil's bucket in which it holds cations.

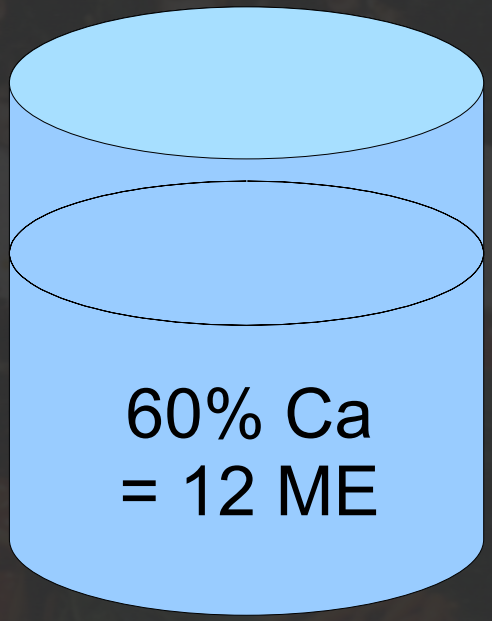


Proper Balance of Cations

Cation Exchange Capacity



CEC = 40 ME



CEC = 20 ME

Taking Soil Sample

- Use clean container and tools
- Sample to the depth recommended by lab
- 10-20 probes in random pattern
- Mix thoroughly and send one cup to lab

Areas to Avoid When Sampling

- Areas with different soils or treatments
- Edges of field
- Where lime or compost piles have been

Location	FAR GARDEN
Crop	BEANS & CORN / CORN & BEANS & OKRA
Field / Sample	
Lab No.	E0096
Total Exchange Capacity (M.E.)	15.56
Desired Ca : Mg, Percent	68 : 12
pH of Soil Sample	5.7
Humus Content, Percent	4.0

BASE SATURATION PERCENT		
Calcium (60 to 70%) } 80%	51.78	
Magnesium (10 to 20%) }	11.73	
Potassium (2 to 5%)	5.90	
Sodium (.5 to 3%)	0.59	
Other Bases (Variable)	6.00	
EXCHANGEABLE HYDROGEN (10 to 15%)	24.00	**RECOMMENDATIONS**

				Amendment	Lbs/1000'
ANIONS	NITROGEN Lbs/Acre	ENR Value	90	**PROTEIN MEAL 11% N (a)**	**9.25 Lbs**
	SULFATE - S p.p.m.	Value Found	13	**SULFUR 90-92% (b)**	**2 Lbs**
	PHOSPHATES as (P2O5) Lbs/Acre	Desired Value Olsen Value Value Found Deficit/Surplus	500 863 +363	**NONE**	

CATIONS	CALCIUM Lbs/Acre	Desired Value Value Found Deficit/Surplus	4232 3223 -1009	CALCIUM CARB (c)	29.75 Lb
	MAGNESIUM Lbs/Acre	Desired Value Value Found Deficit/Surplus	448 438 -10	DOLOMITE (c)	62 Lbs
	POTASSIUM Lbs/Acre	Desired Value Value Found Deficit/Surplus	910 716 -194	POT SULFATE 0-0-50	8.5 Lbs
	SODIUM Lbs/Acre	Desired Value Value Found Deficit/Surplus	72 42 -30		
TRACES	Boron Iron Manganese Copper Zinc	p.p.m. p.p.m. p.p.m. p.p.m. p.p.m.	0.98 371 119 6.10 36.00	BORAX 11% (d) NONE	7.25 oz

Location	DEMO GARDEN	
Crop	ASPARAGUS / ASPARAGUS	
Field / Sample	PLOT 4	
Lab No.	E0087	
Total Exchange Capacity (M.E.)	13.14	
Desired Ca : Mg, Percent	68 : 12	
pH of Soil Sample	8.3	
Humus Content, Percent	0.8	

Previous Analyses & Applications

BASE SATURATION PERCENT		
Calcium (60 to 70%) } 80%		79.38
Magnesium (10 to 20%) }		11.92
Potassium (2 to 5%)		4.50
Sodium (.5 to 3%)		1.11
Other Bases (Variable)		3.09
EXCHANGEABLE HYDROGEN (10 to 15%)		0.00

				RECOMMENDATIONS	
				Amendment	Lbs/1000
ANIONS	NITROGEN Lbs/Acre	ENR Value	32	BEAN SPLITS	321.5 Lbs
	SULFATE - S p.p.m.	Value Found	33	SULFUR 90-92%	14.5 oz
	PHOSPHATES as (P2O5) Lbs/Acre	Desired Value Olsen Value Value Found Deficit/Surplus	750 136 519 -231		
CATIONS	CALCIUM Lbs/Acre	Desired Value Value Found Deficit/Surplus	3574 4172 +598	NONE	
	MAGNESIUM Lbs/Acre	Desired Value Value Found Deficit/Surplus	378 376 -2		
	POTASSIUM Lbs/Acre	Desired Value Value Found Deficit/Surplus	769 461 -308	POT SULFATE 0-0-50	5.75 Lbs
	SODIUM Lbs/Acre	Desired Value Value Found Deficit/Surplus	60 67 +7		
TRACES	Boron	p.p.m.	1.32	BORAX 11%	7.25 oz
	Iron	p.p.m.	38	FE SULFATE 21% (a) (b)	9.25 Lbs
	Manganese	p.p.m.	64	NONE	
	Copper	p.p.m.	0.20	CU SULFATE 23%	11 oz
	Zinc	p.p.m.	25.30	NONE	

Previous Analyses & Applications					
	%		%		%	
	Lbs		Lbs		Lbs	
	Amend	added	Amend	added	Amend	added
	P.P.M		P.P.M		P.P.M	

(OPTIONAL: If compost is applied as recommended.)

(Or 1.75 oz/1000 sq ft per year for 6 years.)

READING KINSEY'S CEC SOIL ANALYSIS REPORT

TEC: This the total Cation Exchange Capacity (CEC) based on the clay and humus content of the soil, measured in milliequivalents (ME).
Average range for sandy soils < 8
Average range for heavy soils 15 - 40

pH: 6 - 6.5 If the exchange capacity is balanced, the pH will come into the correct range.

Humus Content: 2.5 - 7.5 %
Below 2.5 % the microbes are on a starvation diet.
Above 7.5 % certain elements will be tied up.

Target base saturation percentages

Calcium: 60 – 70 % (67 - 69 % for clay soil)
(60 % for sandy soil)

Magnesium: 10 - 20 % (10 - 12 % for clay soil)
(15 - 20 % for sandy soil)

Calcium & Magnesium together should equal 80%

Potassium: 2 - 5 % (3 - 5 % for most crops)
(7.5 % for woody plants)

Sodium: 0.5 - 3 %

Other bases (trace elements): variable

Exchangeable hydrogen: 10 - 15 % = pH 6.0 - 6.5

0 % hydrogen = pH 7.0

Anions: These negatively charged nutrients, such as nitrogen, phosphorus, and sulfur, are held in the soil solution and complexed with organic matter and other elements.

Nitrogen: The **E**stimated **N**itrogen **R**elease (ENR Value) is not an actual measurement of the available nitrogen in the soil. It is an estimate of how much nitrogen will be released during the growing season based on the humus content percentage of the soil. A humus content of 5.1 % will give an ENR of 100 lbs./acre. The actual amount of nitrogen released may vary with the soil and weather conditions.

Sulfates: 25+ ppm

Phosphates: Measured as P_2O_5 in lbs./acre

-Minimum: 300 lbs./acre

-Excellent: 500-750 lbs./acre

Trace Elements: Targets for trace elements in ppm:

	Minimum	Excellent	Excess
Boron	0.8	1.0 +	2.0
Iron	100	200 +	
Manganese	40	125	250 +
Copper	2.0	5.0	10.0 +
Zinc	6.0	10.0 +	20.0

Since trace elements are needed in small amounts, great care should be taken when applying individual trace elements to use the correct amounts and to spread the material evenly. It is helpful to mix trace mineral amendments with sand to make spreading small quantities easier.

Sources of Nitrogen (**N**)

- Compost
- Manure
- Legume crops
- Leguminous green manure
- Protein meal

Sources of Phosphorus (**P**)

- Colloidal phosphate 2-3% P available
- Compost
- Manure

Sources of Potassium (**K**)

- Compost
- Granite dust 5% K very slow release
- Greensand 5% K slow release
- Wood ashes
- Potassium sulfate 50 % K

Sources of Calcium

- High calcium lime 39% Ca
- Dolomite lime 21% Ca, 11% Mg
- Gypsum 24% Ca, 17% S

Sources of Magnesium

- Dolomite lime 21% Ca, 11% Mg
- Magnesium sulfate (Epsom salt) 9% Mg

Sources of Trace Elements

- Boron – Borax 11% boron
- Iron - Iron sulfate 21% iron
- Manganese - Manganese sulfate 32% Mn
- Copper – Copper sulfate 25% copper
- Zinc – Zinc sulfate 35% zinc

Proper Tillage

- Break up compaction
- Improve water in-soak
- Incorporate amendments & organic materials
- Prepare seed bed

Manage Nitrogen

- Apply nitrogen in rotation for best returns
  - Heavy feeder
  - Light feeder
  - Soil builder

In-Row Natural Fertilizer Application

- **Alfalfa pellets**, approx. analysis:
  - N (nitrogen) 2.5%,
  - P (phosphorus) 0.5%,
  - K (potassium) 2.0%
- Incorporate into soil under rows at planting time:
  - Average soil 400 lbs./acre (2.5 lbs./100 ft. row)
  - Poor soil 800 lbs./acre (5 lbs./100 ft. row)

In-Row Natural Fertilizer Application

- **Soybean meal**, approx. analysis
  - N 7.0%
  - P 1.5%
  - K 2.3%
- Drill beside row at planting time or when plants are up:
  - Average soil 200 lbs./acre (1.25 lbs./100 ft. row)
  - Poor soil 400 lbs./acre (2.5 lbs./100 ft. row)

Benefits of Green Manure

- Builds organic matter
- Improves soil structure
- Increases biological activity
- Increases availability of nutrients
  - Legumes fix nitrogen from the air
- Prevents leaching and erosion
- Suppresses weeds
- Decreases insect and disease problems

Rest the Land

- “There is much mourning over unproductive soil, when if men would read the Old Testament Scriptures they would see that the Lord knew much better than they in regard to the proper treatment of land. After being cultivated for several years, and giving her treasure to the possession of man, portions of the land should be allowed to rest, and then the crops should be changed.” FE 323

Pray

If My people, who are called by My name, shall humble themselves and pray, and seek My face, and turn from their wicked ways, then I will hear from Heaven and will forgive their sin and will heal their land. 2 Ch 7:14