It’s All About Soil!

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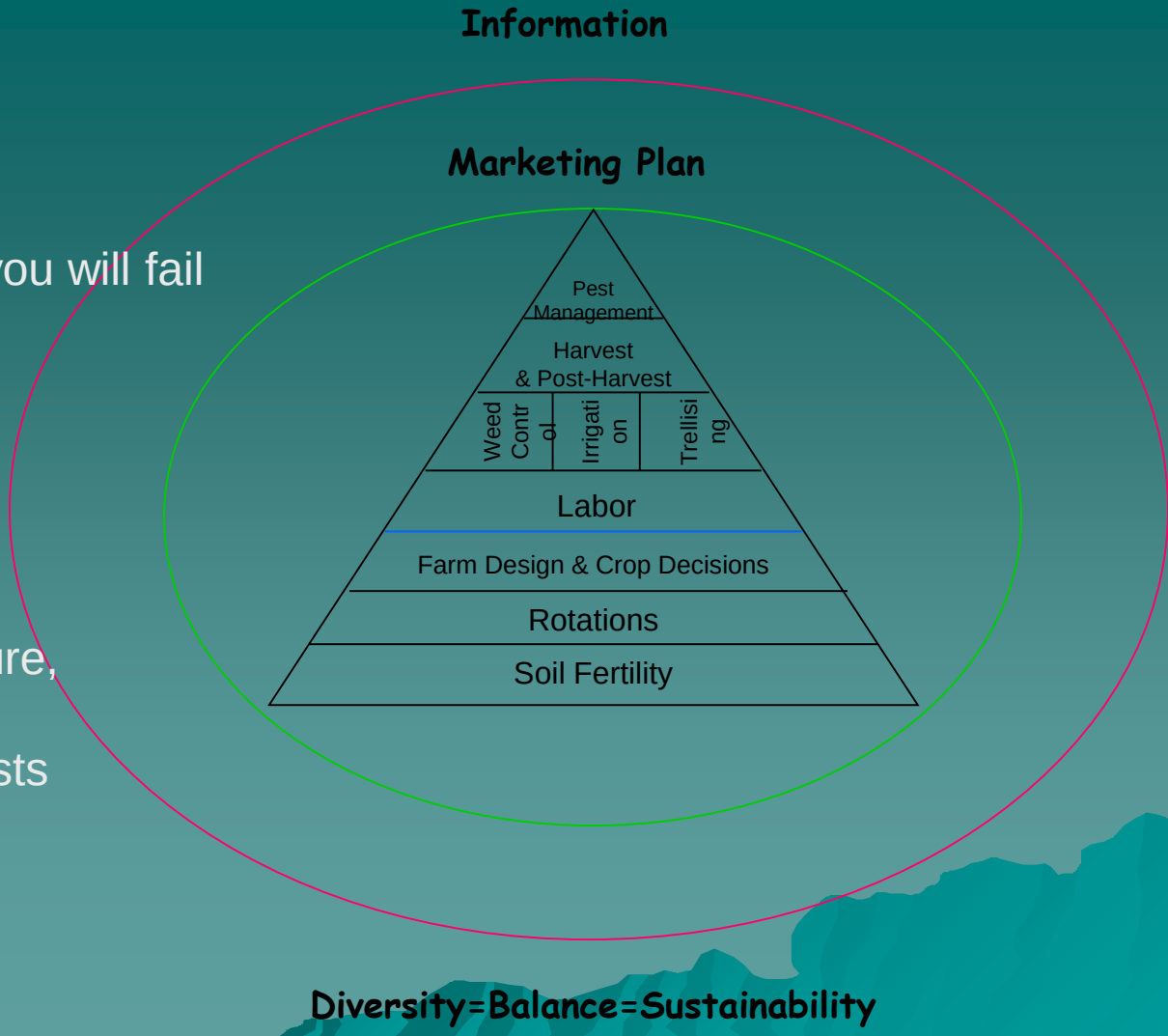
Soil Fertility

-get the soil right

-don't depend on supplements, you will fail

-Two phases
1.Building
2.Maintaining balance

-Sources of Fertility
-on site- nutrient cycling,manure, cover crops
-off site- think about all the costs



Sustainable Soil Management

Three parts of soil

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Three parts of soil

- physical- sand/silt/clay

  can't do much to change other than additions of OM and when, where and how you till

- biological- organic matter and the soil food web that feeds on it

Soil Texture- physical soil

- Buy the best soil you can

- The ideal soil depends on the crop and the production system
  - Sandy loam for early season production
  - Loam or Silt loam for general horticultural crops
  - Clay loams for grain crops especially

Soil Texture

- Tillage is bad but some is usually necessary
- Till when moist but not wet or too dry
- Control compaction
  - Vary tillage equipment
  - Vary tillage depth
  - Use drive lanes

Biological

Organic Matter

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- Where does OM come from?
  - crop residue
  - cover crops
  - manures
  - compost
- What do we get from OM?
  - Food for the Beast
  - Nutrients (N & K)
  - Substances that lead to better soil structure

Biological

Organic Matter

- Inoculate the soil with the beast
  - manure
  - compost

Biological

- Organic matter maintenance
- The right conditions to maximize biological activity (the happy beast):

Biological

Organic matter maintenance

The right conditions to maximize biological activity (the happy beast):

- warmth
- aeration
- moisture
- near neutral pH (6.0 up to 6.5 in cooler climates)

This will release the most nutrients but also

Biological

Organic matter maintenance

- till as little as possible which reduces aeration and warmth
- tilling when either cool or dry will burn up less O.M.
- a reasonable goal is about 1/2 the surrounding natural O.M. levels
- trying to attain the slow burn, constant release during the growing season

Cover Crops

How Cover Crops Improve the Soil

- Increase soil organic matter through additions of plant biomass.
- Form soil aggregates, which stabilize soil and reduce runoff and erosion.
- Increase soil porosity and decrease soil bulk density to promote root growth.
- Improve soil tilth, which reduces crusting and increases the rate of water infiltration.
- Encourage populations of soil microbes, micro- and macro-arthropods and earthworms, all of which contribute to

Cover Crops

Other Benefits of Cover Crops

- Beneficial insect habitat
- Weed suppression
- Reduce soil erosion
- Free nitrogen
- Nematode suppression
- Temporary wind breaks

Legumes and Nitrogen Fixation

- Rhizobium bacteria
- Inoculate or not?
  - Fresh inoculant
  - Correct rhizobia species for the crop
  - Peat based carrier
- Maximum N at about ½ bloom

Cover Crops

- Annuals
  - Winter
  - Summer
- Biennials
- Perennials
  - Short term
  - Long term

- Legumes
- Grasses
- Brassicas

- Combinations are best

Winter Annual Cover Crops

Legumes

- Crimson Clover
- Berseem Clover
- Hairy Vetch
- Winter Peas
- Red Clover
- Balansa Clover

Brassicas

- Rapeseed
- Mustards
- Radishes (oil seed and

Grasses

- Rye (grain)
- Oats
- Wheat
- Triticale
- Barley

LONG

Summer Annual Cover Crops

Legumes

- Soybeans
- Cowpeas
- Velvetbean
- Sunnhemp

Grasses

- Sorghum-Sudangrass
- Millets

- Buckwheat

Buckwheat

Biennial and Perennial Cover Crops

Legumes

- Sweet Clover
- White Clover
- Lespedezas

Grasses

- Fescues
- Perennial Rye grass
- Orchard grass
- Bermuda grass

Nutrient Management

- Cation Exchange Capacity
  - Cation nutrients- K, Ca, Mg
- Soil testing
  - Test at the same time every year (late summer/early fall best)
  - The only way to monitor the mineral nutrients
  - Pull many samples from a field in a Z pattern when soil is not wet

Grower:

Soil Test Report

9/25/2006 SERVING N.C. RESIDENTS FOR OVER 60 YEARS

Agronomist Comments

Field Information		Applied Lime			Recommendations	
Sample No.	*Last Crop*	*Mo*	*Yr*	*T/A*	*Crop or Year*	*Lime*
TOP					1st Crop: Flower, Roots	0
					2nd Crop: Lettuce	0

Test Results

Soil Class	*HM%*	*W/V*	*CEC*	*BS%*	*Ac*	*pH*	*P-I*	*K-I*	*Ca%*	*Mg%*
MIN	0.51	1.16	16.2	98.0	0.3	7.0	84	71	88.0	8.0

Field Information		Applied Lime			Recommendations	
Sample No.	*Last Crop*	*Mo*	*Yr*	*T/A*	*Crop or Year*	*Lime*
FRB					1st Crop: Tomato	0
					2nd Crop: Flower, Roots	0

Test Results

Soil Class	*HM%*	*W/V*	*CEC*	*BS%*	*Ac*	*pH*	*P-I*	*K-I*	*Ca%*	*Mg%*
MIN	0.56	1.22	8.4	90.0	0.8	6.5	84	125	64.0	20.0

Field Information		Applied Lime			Recommendations	

Nutrient Management

- Not just a substitution of materials-rethink the entire system and ecosystem
- Where do they come from?
  - crop residues
  - cover crops
  - manures
  - compost
  - rock powders
  - seed meals
  - animal by-products
- Know your area-do the math!
  - One acre is 43,560 square feet, 208 feet by 208 feet
  - A quarter of an acre is 104 feet by 104 feet
- Keep it simple & close to home

Nutrient Management

- lime- watch Mg
- correct P&K- watch Mg
- cover crops for N and to recycle nutrients
- supplemental N
  - manures
  - seed meals

Liming Materials

- Primarily Ca to raise the pH
  - Calcitic or Hi-Cal 25-40% Ca, <3% Mg
  - Dolomitic 19-22% Ca, 6-13% Mg
  - Wood ashes 23-35% Ca, 2% Mg, 6% K , and some P, fast acting (90% lime equivilant)
  - Ground clam and oyster shells 34% Ca
  - Rock phosphates have 21-33% Ca
- Gypsum is used to add Ca (23%) but will

Phosphorus (P) Materials

- P harder to maintain w/o manures
- Rock phosphate 30% (~3% available)
- Collodial phosphate (Calphos) 20% (~3% available)
- Bone meal 20%
  - Expensive

Potassium (K) Materials

- maintain K mostly through organic matter additions
- Sul-Po-Mag or K-Mag 22%K, 11%mg
- Potassium Sulfate 50%K
- Wood ashes 6%K
- Greensand 7%K

Nutrient Management

What we use today

- lime- dolomitic (would use Hi-Cal)
- Phosphorus (P)- prefer black rock
- Potassium (K)- potassium sulfate 0-0-50
- supplemental N
  - animal by-products- now use feather meal 12%N
  - ~~Manures- Horse, Cow, Turkey~~
  - ~~seed meals- have used soybean~~
- Compost
  - vermi-compost in transplants
  - commercial compost post solarization and where we have insufficient cover crops

Annual Costs

- Dolomitic lime- 1000# X .11 = $106
- Calphos- 750# X .25 = $185
- Potassium Sulfate- 350# X .50 = $175

Total minerals- $466

- Feather meal- 2000# X .36 = $720
- Vermi-compost- 200# X .71 = $142
- Compost- 30 yards X $16 = $484

Total animal by-products = $1346

- Winter cover crop seed = $207
- Summer cover crop seed = $127

Total cover crop seed = $334

Total costs for 3 acres = $2146

Further Information

Books

- Building Soils for Better Crops
  - http://www.sare.org/Learning-Center/Books/Building-Soils-for-Better-Crops-3rd-Edition
- Managing Cover Crops Profitably
  - http://mysare.sare.org/publications/covercrops/covercrops.pdf
- Fertile Soil- A Growers Guide to Organic & Inorganic Fertilizers; Robert Parnes
  - http://www.soilandhealth.org/01aglibrary/010189.fertle%20soil%20revise.pdf
- The real dirt : farmers tell about organic and low-input practices in the Northeast

In the Field

Soil Preparation

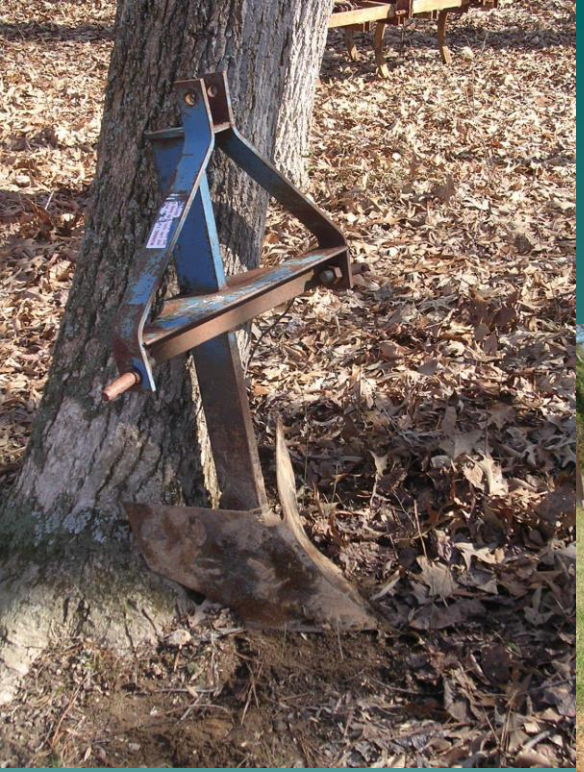
- Do major/deep soil work in fall (or when it's drier)
- Spread mineral soil amendments in fall
- Raised beds drain and warm up faster in the spring
- Turn under cover crop 4 weeks before planting
- Day of planting apply additional N and

Agri Supply
180
DANGER

In the Field

Soil Preparation-Equipment Needs

- Deep soil turning
  - Bottom plow
  - Subsoilers, field cultivators
- Residue incorporation
  - Mower
  - Manure/compost spreader
  - Disk harrow
  - Rototiller
  - Spaders
- Seed bed preparation
  - Bed shapers/hillers
  - Fertilizer spreader
  - Rototiller
  - Rotary Harrow



Rotary Harrows