Soil Testing

- In order to achieve the best possible soil for growing dahlias it is a good idea to have your soil tested.
- The soil test will provide you with:
  - **A description of your soil (mineral or organic)**
  - **Organic Matter (%)**
  - **Soil pH**
  - **Soil nutrient levels (Phosphorus, Potassium, Magnesium, Calcium)**
  - **CEC (Cation Exchange Capacity)**
  - **% Exchangeable Bases (Potassium, Magnesium and Calcium)**
  - **Tests for micronutrients are usually extra**
- With a soil analysis in hand you can make the necessary changes to achieve the 'ideal' soil for growing dahlias.

Outline of Presentation

- Basics of Soil Science
  - Soil Structure
  - Plant Nutrients
    - Macro/micro nutrients
    - Cations/anions
  - Cation Exchange Capacity
  - How plants take up nutrients
- Soil Test Parameters Explained
  1. **A description of your soil**
  2. **Organic Matter (%)**
  3. **Soil pH**
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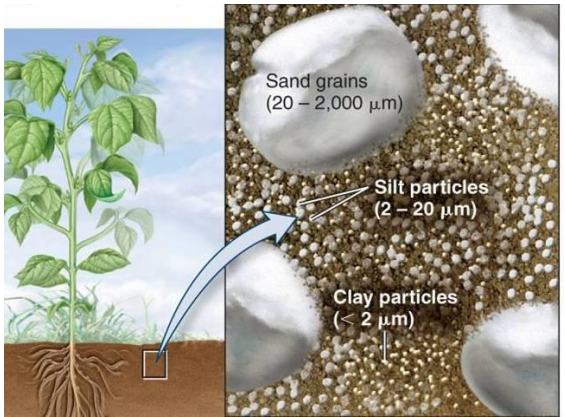
Soil Structure

- Soils consist of
  1) **minerals**
  2) **humus** (soil organic mater)
  3) **air** (oxygen)
  4) **water**
  5) **microorganism** (bacteria and fungi)

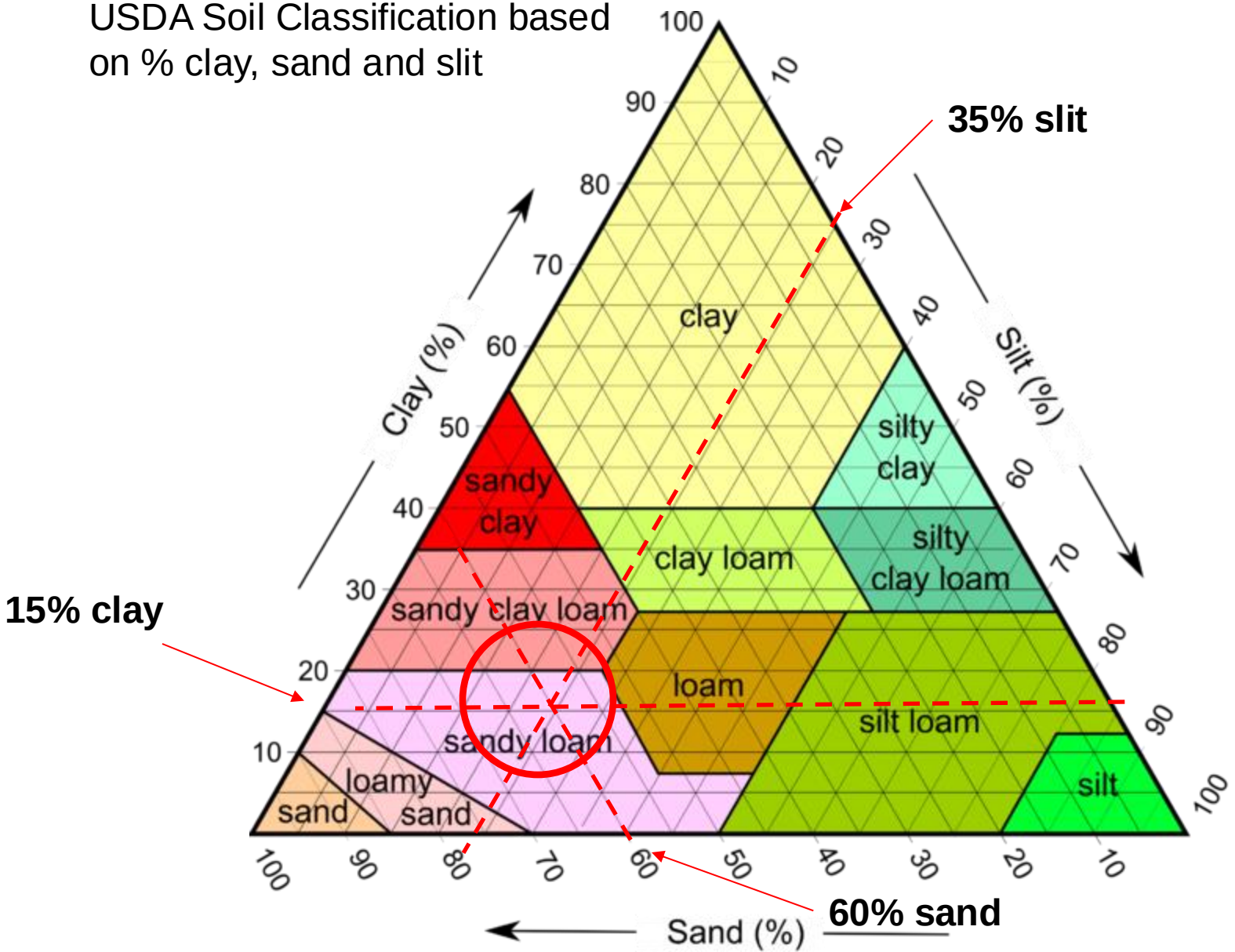
Soil Structure: 1) Soil Minerals

- The **texture** of topsoil depends on the size of its particles
- The **minerals** in soil consist of primarily
  - **sand, silt and clay**
  - differentiated by particle size
    - sand being the largest and clay the smallest (microscopic)
- The mineral component of soils is responsible for attracting and holding nutrients (more about this later)
- Soils are a mixture of all three mineral components and all are essential for normal plant growth.



Sand ~12 particles/inch
Silt ~ 500 particles/inch
Clay ~ 12,500 particles/inch

USDA Soil Classification based on % clay, sand and slit

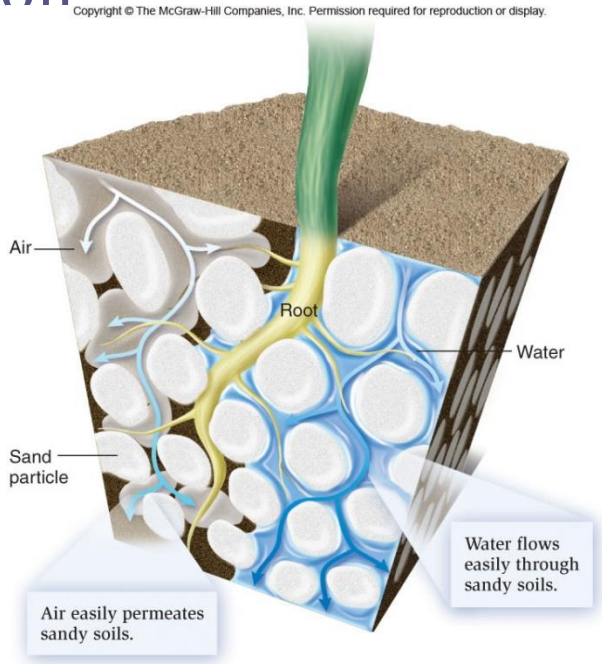


Importance of Soil Texture

- Soil texture affected by the % sand, silt and clay
  - affects the ability of soils to hold nutrients against the gravitational pull of water moving through the soil (see CEC section below),
- Soil texture also affects **soil tilth**
  - soil drainage
  - soil moisture
  - air movement in the soil
  - root penetration
  - microbial activity
- Thus a good balance of sand, silt and clay will not only improve nutrient availability,
  - but also provide good drainage,
  - good soil moisture,
  - a soil that is easy to cultivate,
  - one that has good air movement and
  - one that allows good root penetration

Importance of Soil Texture

- Sandy soils (well aerated due to large pore size)
  - Well aerated **benefits**:
    - Allow air and water to move rapidly
    - Favorable for growth of plant roots, because they require oxygen for cellular respiration
  - Well aerated **drawbacks**
    - rapid percolation of water through sandy soils reduces the amount of water available to the roots and
    - leaches minerals from the soil



Importance of Soil Texture

- Soils higher in silt and clay (less porous)
  - **Benefits** of being less porous
    - Silt and clay particles fit closely together so water percolates less easily so more nutrients and water are retained
  - **Drawbacks** of less porous soils
    - water retention and
    - low oxygen availability

Soil Structure: 2) Soil Organic matter

- Soil organic matter (SOM)
  - consists of plant and animal residues at various stages of decomposition
  - living organisms (earthworms, nematodes, arthropods, microbes and the substances they produce, fungi and mycorrhizal fungi
  - **Humus**
    - (the end product from the final stages of decomposition, that is resistant to further decomposition
    - It is what gives soil its dark brown color
    - Generally the darker the soil the more humus there is

- SOM plays a vital role in soil health, structure (**tilth**) and fertility.

- Soil Structure and tilth
  - SOM prevents clay from packing together and builds a **crumbly soil** that retains water but is still porous enough for the adequate aeration of roots.
  - Reduction in soil compaction-
    - OM is spongy in nature and provides resilience
  - Increases root penetration-
    - OM keeps soil loose and airy

- SOM is important in storing and retaining nutrients
  - SOM is reservoir for soil nitrogen, phosphorus, calcium, magnesium, sulfur, and more (about 2.5% by weight of leaves are minerals)
  - SOM Increases soils ability to hold nutrients
    - **Humus** has a Cation Exchange Capacity (CEC) ~50x that of clay and holds and greatly improves soils ability to retain minerals and prevents them from leaching from the soil
  - Improved water relations- SOM holds 10x more water than mineral soil

Increasing SOM

- Addition of organic material
  - shredded leaves, grass clippings, plant material
- Addition of high quality compost (organic material at various stages of decomposition)
  - This will also contain microorganisms (bacteria and fungi) necessary to decompose the organic **material** and covert it to organic **matter** and **humus** and release the nutrients stored in the leaves (mineralization)
- Regular additions of SOM are necessary since it is continually being broken down (consumed by soil biota)

Soils are Categorized as:

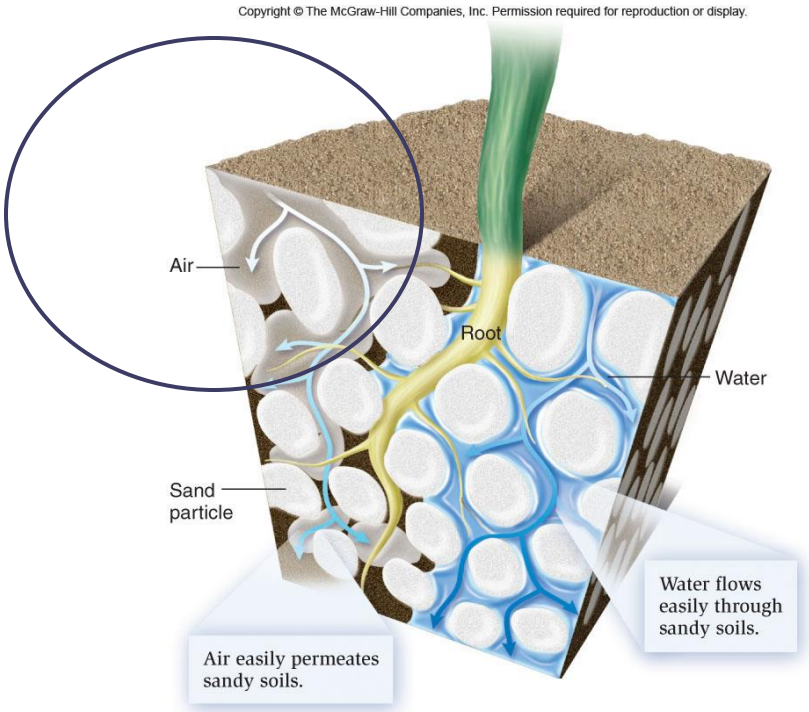
- **Mineral**
  - Organic content less than 20-35%
- **Organic**
  - Organic component is greater than 20-35%

Modifying Soil Structure (physical nature)

- Improving soil structure
  - Add organic matter
  - Encourage earthworms
  - Adding mulch/compost (with soil biota)
- Destroying soil structure
  - Cultivating the soil when it is too wet or dry
  - Compacting soil (walking, using heavy equipment)
  - Minimize tilling (disturbing biota)

Soil Structure: 3) Air

- Air (oxygen) is vital for cellular respiration and the growth of plant roots
- Well aerated soils have spaces or pores that fill with air



Soil Structure: 4) Water

- Essential for several reasons
  - As a **nutrient** (source of most hydrogens and some oxygens in plant organic compounds)
  - **Solvent** for other mineral nutrients which allows plants to adsorb nutrients
  - Main **transport** medium in plants
- Typically 90% of weight of living plants
- All plants require an adequate supply for active metabolism and growth

Soil Structure: 5) Microorganisms

- A teaspoon of soil has about 5 billion bacteria that cohabit with various fungi, algae and other protists, insects, earthworms, nematodes, and the roots of plants.

- The activities of these organisms affect the physical and chemical properties of the soil.
  - For example, earthworms aerate soil by their burrowing and add mucus that holds fine particles together (aggregates)
  - Bacterial metabolism alters mineral composition of soil (mineralization)
  - Plant roots extract water and minerals but also affect soil pH and reinforce the soil against erosion.

- **In the past soil tests do not measure your soils biota (but tests are now available)**

Microorgamisms--Biological sources of plant nutrients

- Mycorhizzal (fungus-roots) associations
  - About 90% of seed plants have fungal symbiotic associations
  - Fungi either penetrate the root tissues or envelop root surfaces
  - Fungi obtain organic food from plant while fungi supplies water and mineral nutrients
  - Very efficient way to harvest water and minerals (especially phosphorus) from a larger volume of soil

Importance of myccorhizal fungi in plants ability to acquire phosphate

- Low levels of phosphorus limits plant growth
- Phosphorus may be abundant in soil **but unavailable to plants**
- **Fungal symbiotic associations**, highly branched roots, more or longer root hairs, and secretion of protons and organic acids **can help acquire more phosphorus**

Mycorrhizal fungi extend the nutrient extraction zone in the soil

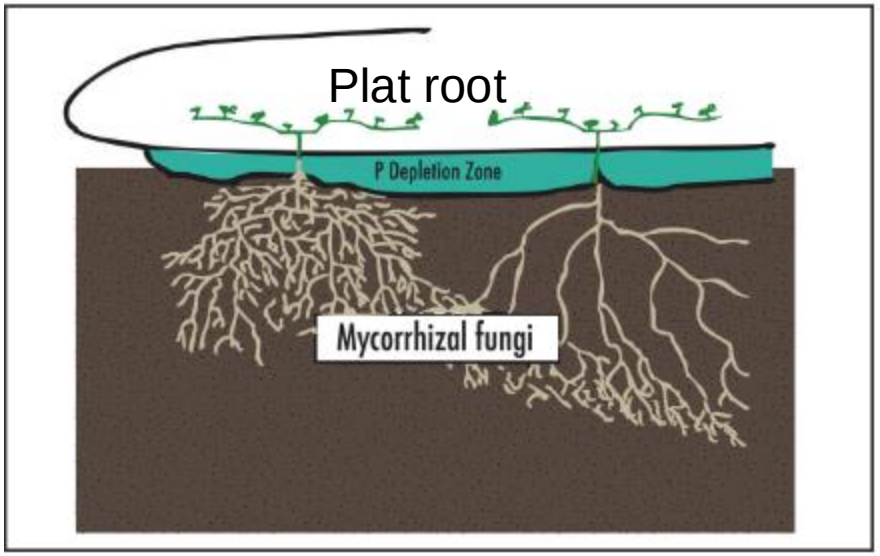
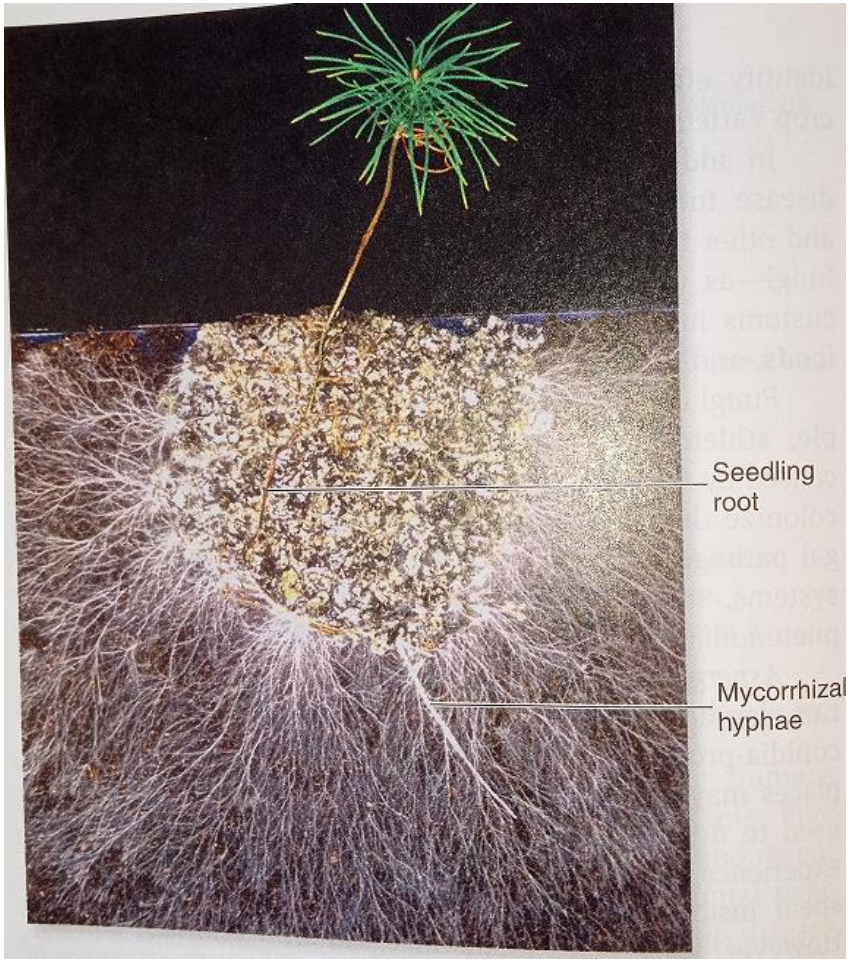


Figure 1. The P depletion zone surrounds a plant root. Mycorrhizal fungi can extend the nutrient extraction zone up to several centimeters out into the soil.



- Abiotic factors that affect the activity of mycorrhizal fungi
  - **soil fertility, temperature, pH, soil moisture and aeration, soil type, salinity, plant readiness for infection, soil organic matter**
- **Factors negatively affect mycorrhizal fungi**
  - **Soil disturbance such as tilling has a negative effect on fungi**
  - Pesticides applied to the foliage of plants generally do not have any adverse effects on mycorrhizae formation or function.
  - Some fungicides applied to soil do inhibit mycorrhizae; **soil fumigants** can kill mycorrhizal fungi.

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Plant nutrients

- **Two types:**
  - **Macronutrients –**
    - **Needed in larger quantities**
  - **Micronutrients –**
    - **Only trace amounts needed**
- When plants lack essential nutrients they display deficiency symptoms
  - Failure to reproduce, tissue death, and changes in leaf color
  - Chlorosis – yellowing of leaves

- **Macronutrients**
  - Nine essential nutrients required in large amounts
  - carbon, oxygen, hydrogen, nitrogen, potassium, calcium, magnesium, phosphorus, sulfur

Table 37.1 Essential Elements in Plants

Element	Form Available to Plants	% Mass in Dry Tissue	Major Functions
Macronutrients			
Carbon	CO_2	45%	Major component of plant's organic compounds
Oxygen	CO_2	45%	Major component of plant's organic compounds
Hydrogen	H_2O	6%	Major component of plant's organic compounds
Nitrogen	NO_3^-, NH_4^+	1.5%	Component of nucleic acids, proteins, hormones, chlorophyll, coenzymes
Potassium	K^+	1.0%	Cofactor that functions in protein synthesis; major solute functioning in water balance; operation of stomata
Calcium	Ca^{2+}	0.5%	Important in formation and stability of cell walls and in maintenance of membrane structure and permeability; activates some enzymes; regulates many responses of cells to stimuli
Magnesium	Mg^{2+}	0.2%	Component of chlorophyll; activates many enzymes
Phosphorus	$H_2PO_4^-$, HPO_4^{2-}	0.2%	Component of nucleic acids, phospholipids, ATP, several coenzymes
Sulfur	SO_4^{2-}	0.1%	Component of proteins, coenzymes

Micronutrients—minor elements

- These are only 'minor' in the amounts required compared to other minerals
- They **must** be available and in balance for a truly healthy soil

Table 37.1 Essential Elements in Plants

Element	Form Available to Plants	% Mass in Dry Tissue	Major Functions
Micronutrients			
Chlorine	Cl^-	0.01%	Required for water-splitting step of photosynthesis; functions in water balance
Iron	Fe^{3+}, Fe^{2+}	0.01%	Component of cytochromes; activates some enzymes
Manganese	Mn^{2+}	0.005%	Active in formation of amino acids; activates some enzymes; required for water-splitting step of photosynthesis
Boron	$H_2BO_3^-$	0.002%	Cofactor in chlorophyll synthesis; may be involved in carbohydrate transport and nucleic acid synthesis; role in cell wall function
Zinc	Zn^{2+}	0.002%	Active in formation of chlorophyll; activates some enzymes
Copper	Cu^+, Cu^{2+}	0.001%	Component of many redox and lignin-biosynthetic enzymes
Nickel	Ni^{2+}	0.001%	Cofactor for an enzyme functioning in nitrogen metabolism
Molybdenum	MoO_4^{2-}	0.0001%	Essential for symbiotic relationship with nitrogen-fixing bacteria; cofactor in nitrate reduction

Micronutrient Interactions

- **Boron-needed so plants can utilize calcium**; generally should be 3-4 ppm
- **Copper and zinc- work together**; need to be in balance 1 part copper to 2 parts zinc

- Not part of a routine soil test, you must request it (and of course pay extra for it!)

Plant nutrients Come in Two Forms:

- Positively charged nutrients— **cations**
  - potassium (K^+)
  - calcium (Ca^{2+})
  - magnesium (Mg^{2+})
  - Sodium (Na+)
- Negatively charged nutrients—**anions**
  - nitrate (NO_3^-),
  - phosphate ($H_2PO_4^-$)
  - sulfate (SO_4^{2-})

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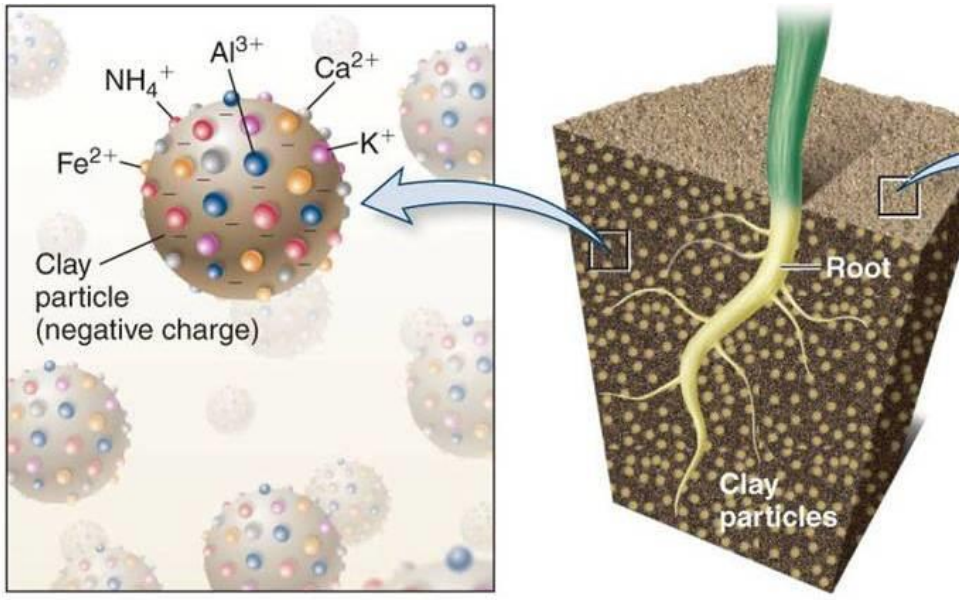
Cation Exchange Capacity in Soils

- Clay particles have negatively charged sites that attract and hold positively charged particles or cations (electric attraction)
- Soil humus has both positive and negative charges, so it can hold on to both cations and anions.



(a) Electrostatic attraction between clay particles and mineral ions

- **Cation Exchange Capacity (CEC)** is *the* ***measure of how many negatively-charged sites are available in your soil*** *and* *the ability of your soil to hold and release nutrients*

Mineral Retention in Soil

- **Clay** in soil and **humus** prevents the leaching of mineral nutrients during heavy rain or irrigation because of the large surface area of negative charges for binding minerals.
- Cation exchange capacity (CEC) is a fundamental soil property used to predict plant nutrient availability and retention in the soil.

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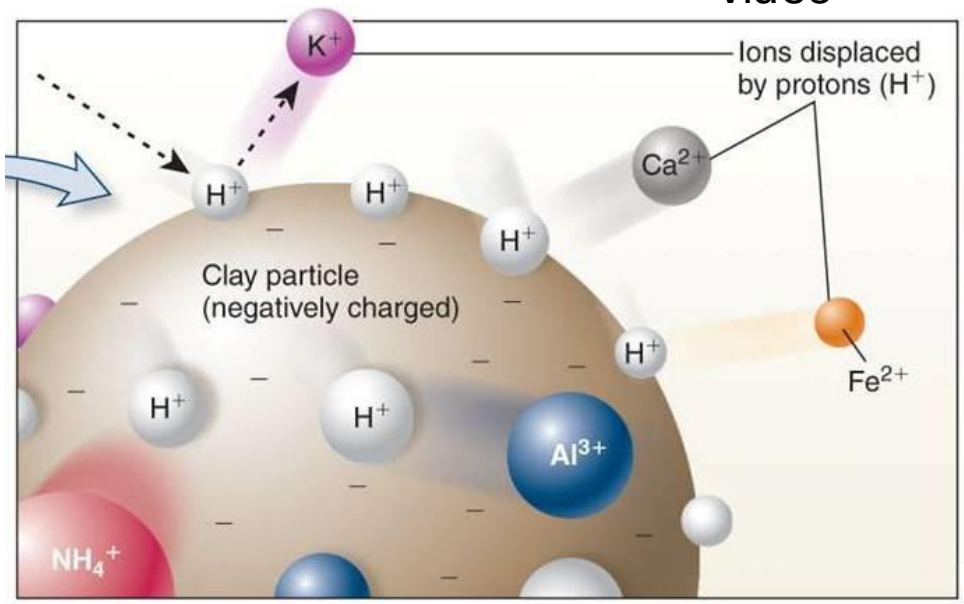
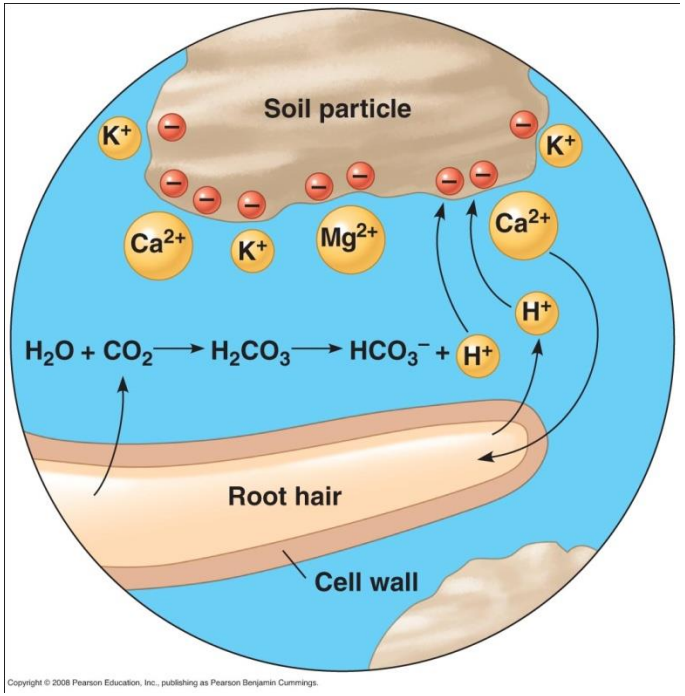
How do plants take up nutrients

- Positively charged mineral ions are made available to the plant when hydrogen ions in the soil displace the mineral ions from the clay/humus particles.
  - This process, called cation exchange, is stimulated by the roots which secrete H^+ and compounds (CO_2) that form acids in the soil solution with the release of H^+

video



(b) Cation exchange



Adjusting Soil pH

- **Soil pH** affects **cation exchange** and the **chemical form of minerals**
- **Cations are more available in slightly acidic** soil, as H^+ ions displace mineral cations from clay particles

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Example of current basic soil test from MSU

MICHIGAN STATE UNIVERSITY | Extension MSU Soil Test.com

Soil Test (#F84257) Report for [redacted] – 110813 Dahlia (crop: Flowers, Perennials)

		Below Optimum	Optimum	Above Optimum
Phosphorus (P)	107 ppm			
Potassium (K)	129 ppm			
Magnesium (Mg)	363 ppm			
Calcium (Ca)	2254 ppm			
CEC	14.626 meq/100 g			
Soil type	MINERAL , Sandy loam			
Soil pH	7.3			
Lime index	0			
Organic Matter	6.5 %			

Example of older basic soil test from MSU

MICHIGAN STATE UNIVERSITY

SOIL TEST REPORT FOR:	CONSULTANT
KEITH BERVEN BERVEN@OAKLAND.EDU 234 E. SHADBOLT LAKE ORION MI 48362	WOJO'S GREENHOUSE C/O OAKLAND COUNTY MSUE 248-858-0880

DATE	LAB #	COUNTY	GROWER'S EMAIL	ACRES	FIELD ID	SOIL
5/13/2011	137003	Oakland	stlmsu@yahoo.com		Dahlia	Mineral

Next to Lake or Stream?	Year Area Planted	Fertilizer Tilled in Prior to Planting?	How Deep?
No	This Year		7 Inches

SOIL NUTRIENT LEVELS

			Below Optimum	Optimum	Above Optimum
[1]Soil pH 6.8	Lime Index				
[2]Phosphorus (P)	391	ppm			
[3]Potassium (K)	233	ppm			
[3]Magnesium (Mg)	317	ppm			

ADDITIONAL RESULTS:

[3]Calcium (Ca) (ppm)	CEC (meq/100 g)	% of Exchangeable Bases K	% of Exchangeable Bases Mg	% of Exchangeable Bases Ca
1784	12.2	4.9	21.7	73.4

Optional Tests:

Micronutrients (ppm) B	Cu	Mn	Zn	Fe	Organic Matter %	Nitrate-N ppm
					6.5	

RECOMMENDATIONS FOR: *Flower Beds, annuals*

Limestone: NONE

NUTRIENT NEEDS:

Nitrogen (N)	Phosphate (P_2O_5):	Potassium (K_2O):	Target pH:
3 lb/1000 sq ft	NONE	NONE	6.0

FERTILIZER OPTIONS:

lb/A

BROOKSIDE LABORATORIES, INC.

41630-12

SOIL AUDIT AND INVENTORY REPORT

Name A Plus Ag Consultants City Rochester Hills State MI

Independent Consultant A Plus Ag Consultants Date 07/11/2012

Sample Location	KEITH BERREN		-				
Sample Identification							
Lab Number			0841-1				
Total Exchange Capacity (ME/100 g)			18.65				
pH (H_2O 1:1)			6.2				
Organic Matter (humus) %			9.06				
Estimated Nitrogen Release		lb/A	120				
ANIONS	SOLUBLE SULFUR*	ppm	28				
ANIONS / PHOSPHORUS	MEHLICH III	lb/A P as P_2O_5	1447				
		ppm of P	316				
	BRAY II	lb/A P as P_2O_5	1951				
		ppm of P	426				
	OLSEN	lb/A P as P_2O_5					
		ppm of P					
EXCHANGEABLE CATIONS	CALCIUM*	lb/A	4860				
		ppm	2430				
	MAGNESIUM*	lb/A	622				
		ppm	311				
	POTASSIUM*	lb/A	418				
		ppm	209				
	SODIUM*	lb/A	76				
		ppm	38				

BASE SATURATION PERCENT		
Calcium	%	65.15
Magnesium	%	13.90
Potassium	%	2.87
Sodium	%	0.89
Other Bases	%	5.20
Hydrogen	%	12.00

EXTRACTABLE MINORS	
Boron* (ppm)	0.62
Iron* (ppm)	262
Manganese* (ppm)	30
Copper* (ppm)	5.63
Zinc* (ppm)	45.73
Aluminum* (ppm)	548

More complete soil test—with addition of minor elements and complete base saturation

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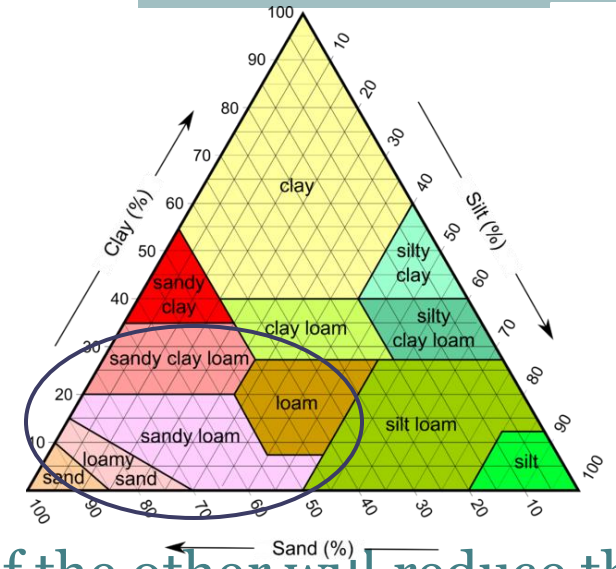
Ideal Dahlia Soil



- **Sandy loam**
  - **50-60% sand**
  - **0-10% silt**
  - **10-25% clay**
  - **6-20% organic matter.**
  - Increasing one at the expense of the other will reduce the productivity of the soil.
- Loamy soils have enough fine particles to provide a large surface area for retaining minerals and water, which adhere to the particles.
- Loams also have enough course particles to provide air spaces that supply oxygen to the root for cellular respiration.
- The proper mixture of these 3 mineral components (sand, silt, and clay) will **assure good nutrient holding capacity and provide good water drainage and aeration.**

1) Description of soil

MICHIGAN STATE UNIVERSITY | Extension MSU Soil Test.com

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CEC	14.626 meq/100 g			
Soil type	MINERAL , Sandy loam			
Soil pH	7.3			
Lime index	0			
Organic Matter	6.5 %			

Soil Description

- Some soil tests will give you a breakdown of the % clay slit and sand.

BROOKSIDE LABORATORIES, INC.

** PHYSICAL ANALYSIS REPORT **

ith Berven

File Number: 52891
Date Received: 10/13/2009
Date Reported: 10/15/2009

Submitted By: A Plus Ag Consultants

SAMPLE LOCATION: DAHLE

NBR	FIELD	DESCRIPTION	Clay (%)	Silt (%)	Sand (%)
001	-		1.34	15.21	83.45

ORGANIC

Dahlia members soil types

- Wilson Sandy loam
- Dave Sandy loam
- Don Mineral loamy sand
- Keith Sandy loam
- Fred Mineral
- Sherree Mineral
- Melissa Mineral
- Jeff Mineral (loam)

Soil Testing

- A soil test will provide you with:
  1. **A description of your soil**
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2) Description of soil organic matter

MSU Soil Test.com - Personalized Recommendations for Your Lawn and ... Page 1 of 2

MICHIGAN STATE UNIVERSITY | Extension MSU Soil Test.com

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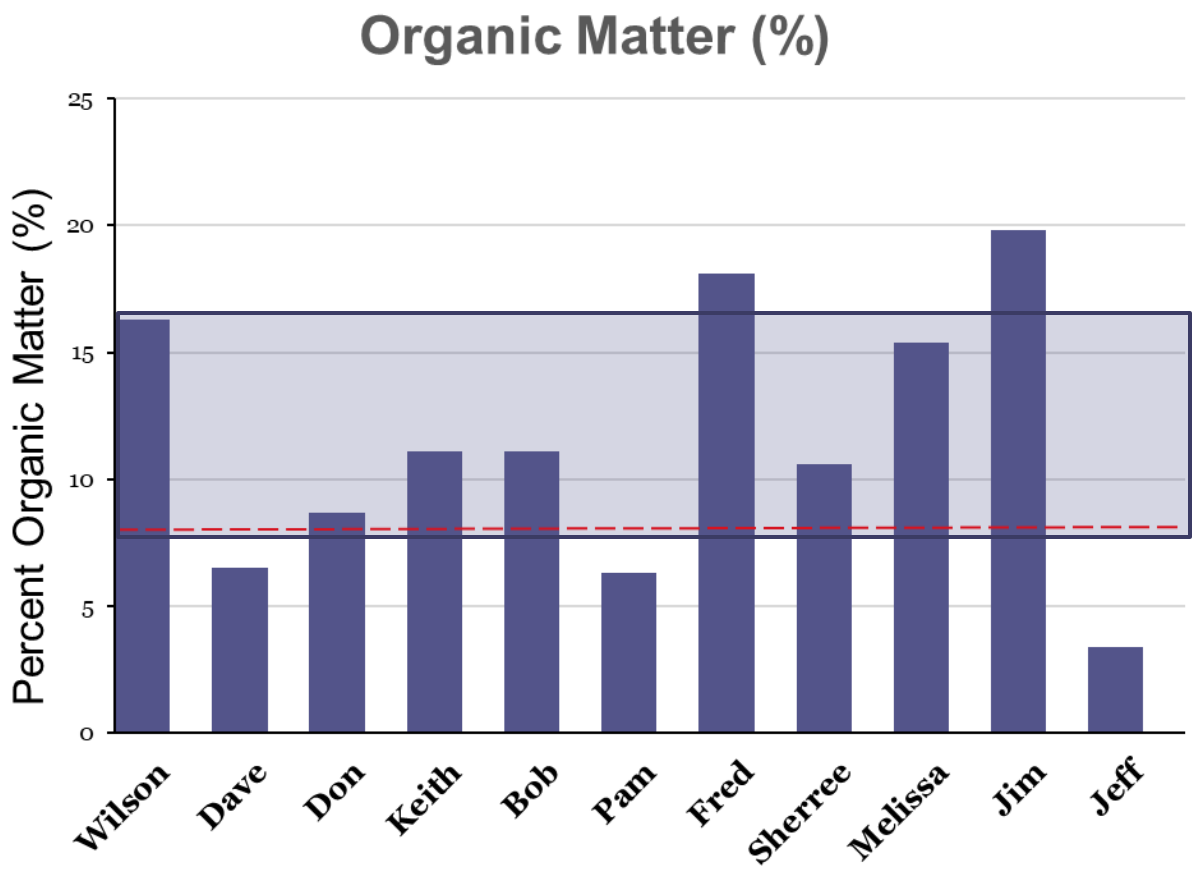
CEC	14.626 meq/100 g			
Soil type	MINERAL , Sandy loam			
Soil pH	7.3			
Lime index	0			
Organic Matter	6.5 %			

Soil Organic matter

- What is being measured is the % **humus** in soil

- Organic poor soils have less than 1% organic matter
- Organic rich soils have more than 8% organic matter
- Optimal growth generally requires near 8% because organic matter helps soils hold more water and ions
- For dahlias recommendation is 8-16%

Dahlia members soil organic matter



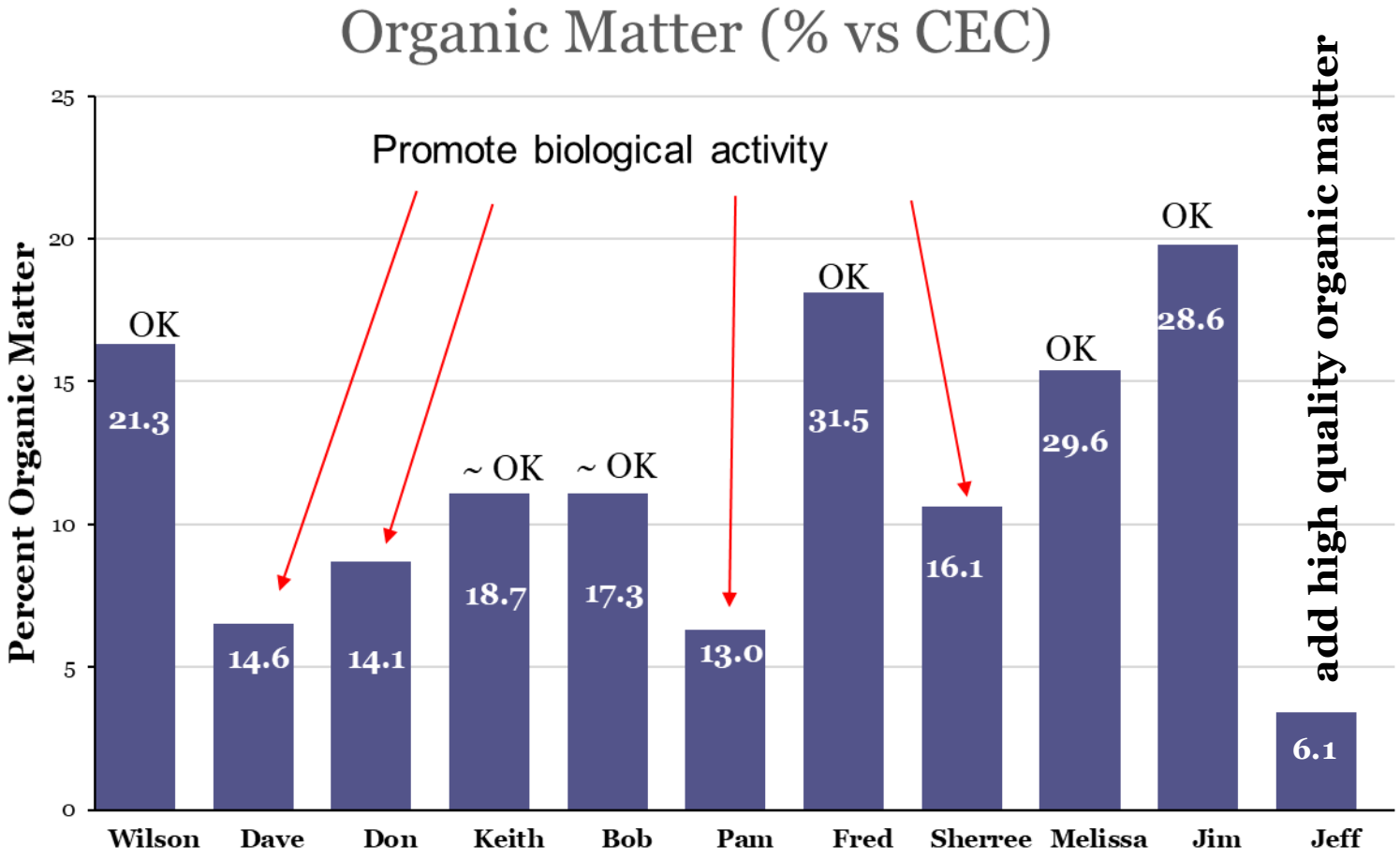
Recommendations for improving organic matter in soil related to CEC (ability of soil to hold nutrients)

Organic Matter Reading	C.E.C. Reading	Action to Take
Less than 2	Any	Add organic matter
Below 5 but above 2	Under 20	Add high quality organic matter
Below 5 but above 2	Over 20	Maintain organic matter
Above 5	Under 20	Promote biological activity
Above 5	Over 20	Don't add

↑

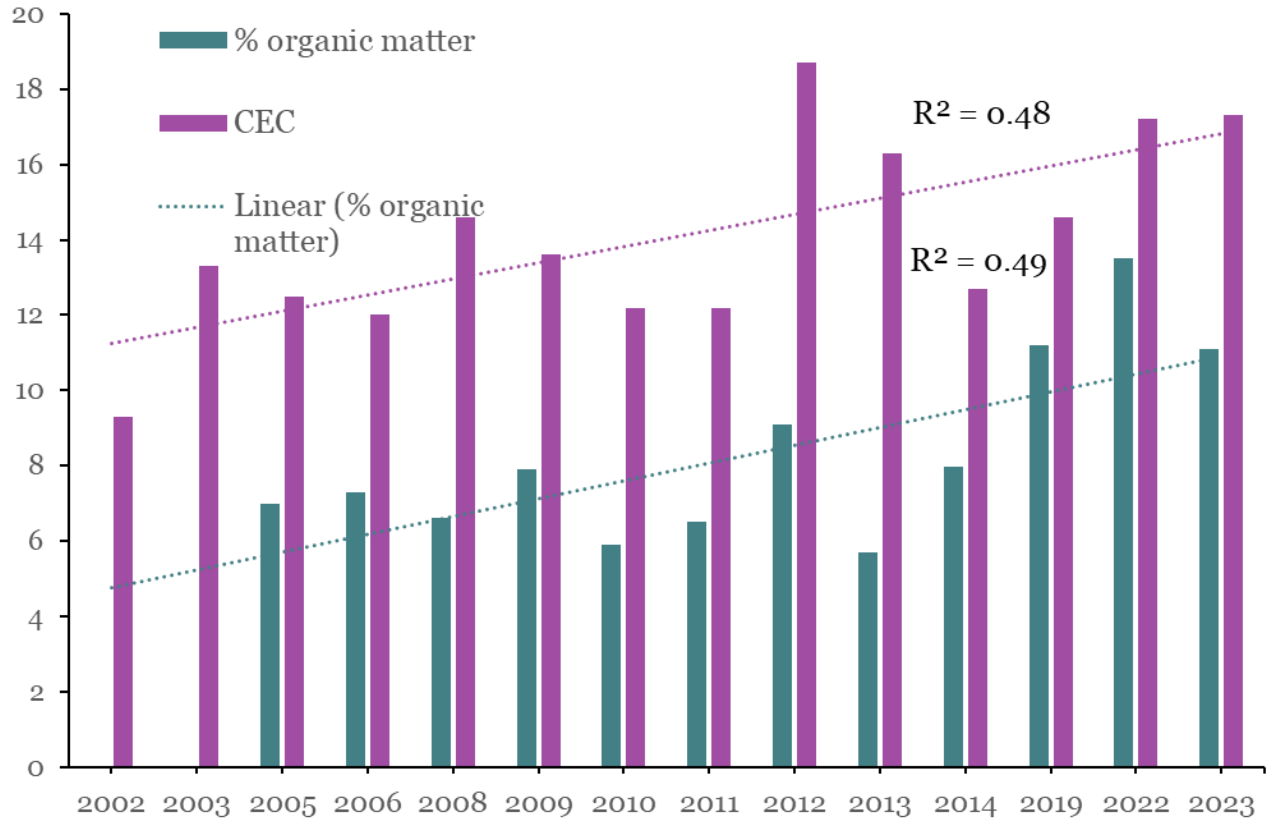
Reflection of **humus** in soil resulting from decomposition of organic material by soil microorganisms

Dahlia members soil organic matter



Cation exchange capacity shown in white

Relationship between CEC and % organic matter from 2002-2023 in my dahlia garden



How to increase humus in your soil

- By adding organic matter and having healthy soil microorganism that can break it down
- Add other soils that contain high amounts of humus
- Add commercial soil conditioners

Soil Testing

- A soil test will provide you with:
  1. **A description of your soil**
  2. **Organic Matter (%)**
  3. **Soil pH**
  4. **CEC (Cation Exchange Capacity)**
  5. **% Exchangeable Bases (Potassium, Magnesium and Calcium)**
  6. **Soil nutrient levels (Phosphorus, Potassium, Magnesium, Calcium)**

3. Soil pH (potential hydrogen)

MICHIGAN STATE UNIVERSITY | Extension MSU Soil Test.com

Soil Test (#F84257) Report for Dave Walton – 110813 Dahlia (crop: Flowers, Perennials)

		Below Optimum	Optimum	Above Optimum
Phosphorus (P)	107 ppm			
Potassium (K)	129 ppm			
Magnesium (Mg)	363 ppm			
Calcium (Ca)	2254 ppm			
CEC	14.626 meq/100 g			
Soil type	MINERAL , Sandy loam			
Soil pH	7.3			
Lime index	0			
Organic Matter	6.5 %			

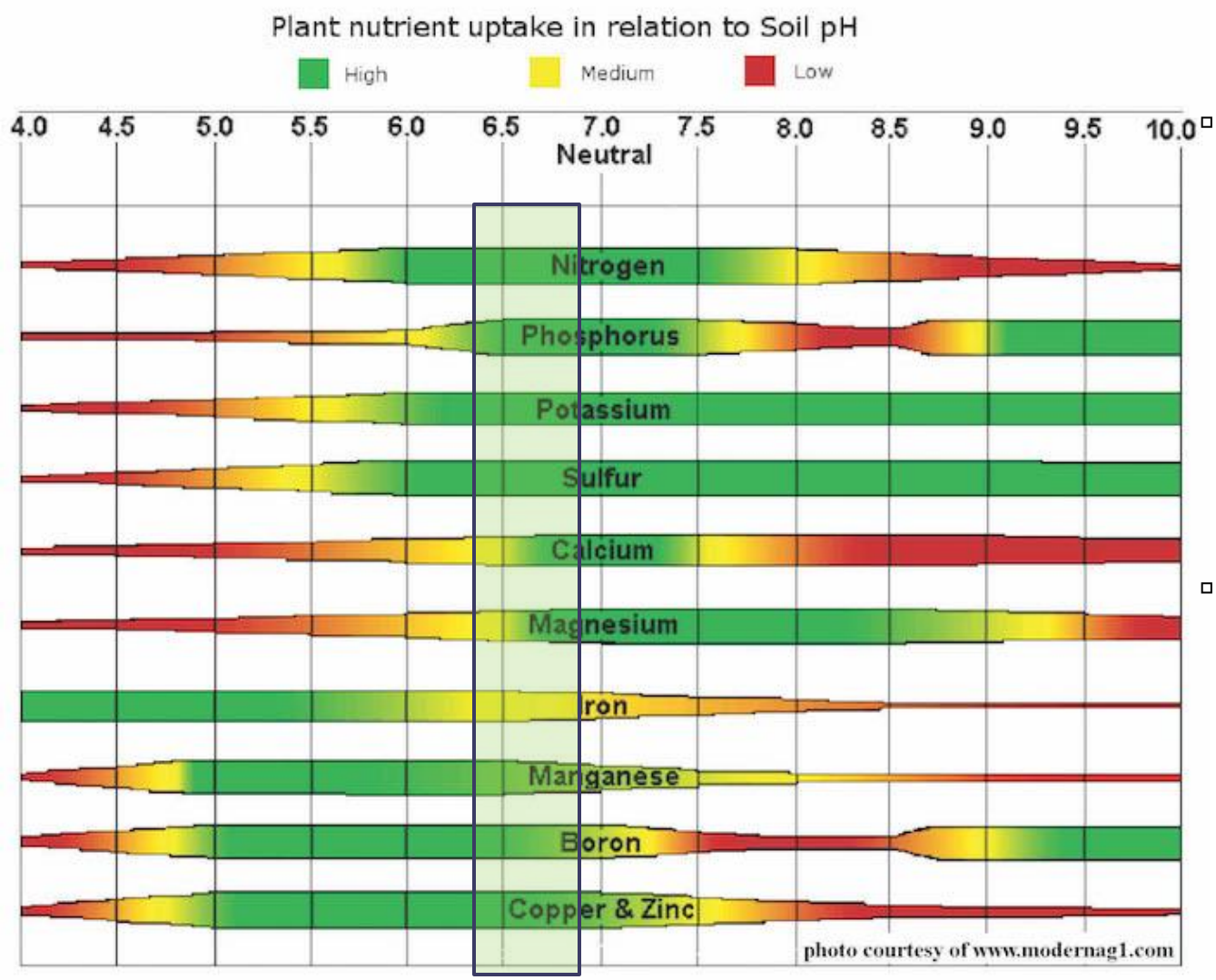
Soil Acidity and Alkalinity (pH)

- The ideal pH for dahlias is between **6.4 and 6.8** or slightly acidic.
- You can adjust the pH of your soil with the addition of lime (to increase the pH) or sulfur (to decrease the pH). Your soil report will generally provide a recommendation.

Soil Acidity and Alkalinity (pH)

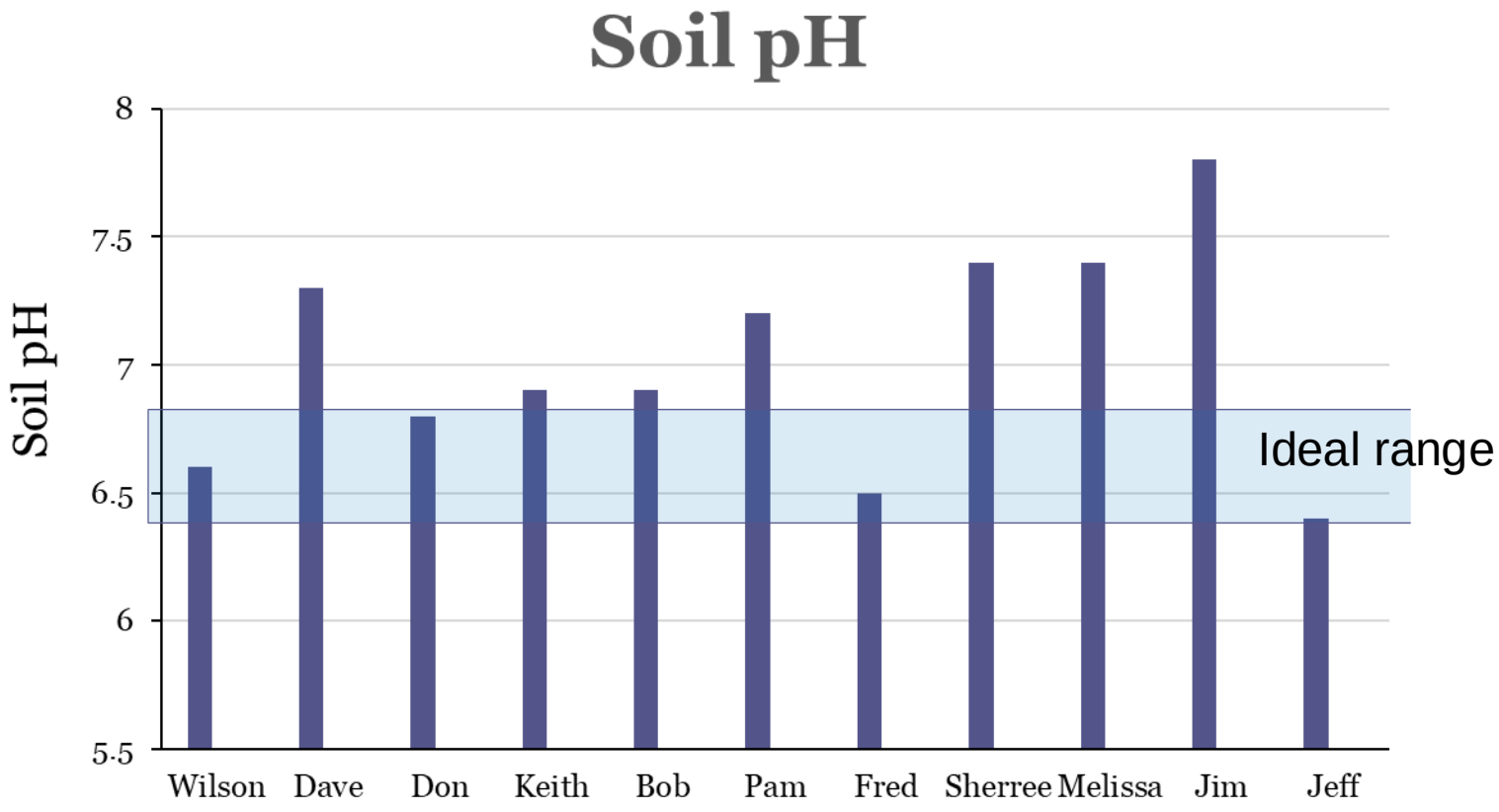
- The **pH of your soil is critical because it affects nutrient availability.**
- The effect of soil pH is great on the solubility of minerals or nutrients.
  - Before a nutrient can be used by plants it must be dissolved in the soil solution.
  - **Most minerals and nutrients are more soluble or available in acid soils** than in neutral or slightly alkaline soils.
    - Phosphorus is never readily soluble in the soil but is most available in soil with a pH range centered around 6.5.
  - Soil pH can also influence plant growth by its effect on activity of beneficial microorganisms.
    - In strongly acidic soils, bacteria are unable to decompose soil organic matter, limiting the release available nutrients, particularly nitrogen, which are held in the organic matter

Optimum plant nutrient uptake varies with pH



- At higher pH values (> 7.0) the availability of **phosphorus, boron, copper, iron and manganese and zinc decreases.**
- For more acidic soils (<6.4) the availability of **nitrogen, phosphorus potassium, sulfur, calcium and magnesium decreases.**

Dahlia members soil pH



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4. CEC-Cation Exchange Capacity

MICHIGAN STATE UNIVERSITY | Extension MSU Soil Test.com

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Lime index	0			
Organic Matter	6.5 %			

4. Cation Exchange Capacity (CEC)

- The Exchange Capacity of your soil is a measure of its ability to hold and release various plant nutrients
- The positively charged nutrients that we are mainly concerned with are
  - **Calcium (Ca^{++})**
  - **Magnesium Mg^{++})**
  - **Potassium (K^{+})**
  - **Sodium (Na^{+})**
- These are all alkaline cations, also called basic cations or bases

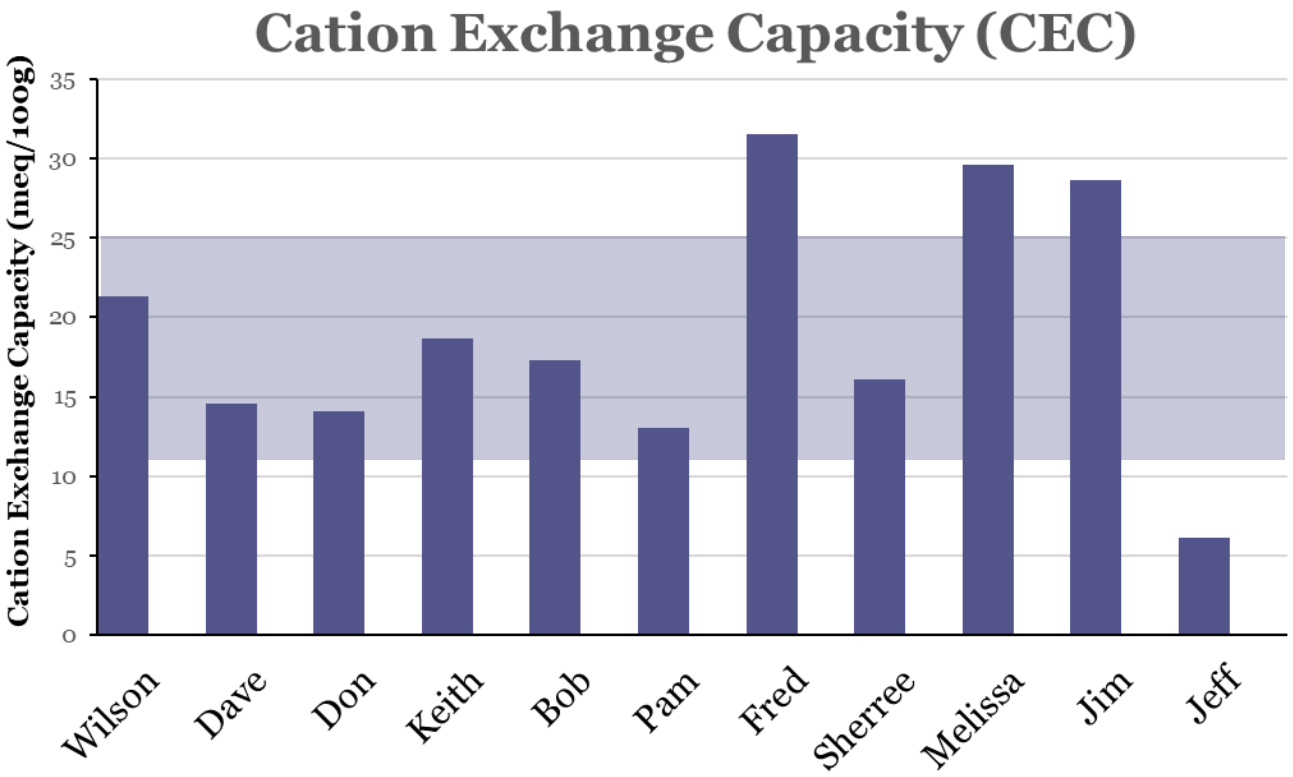
Cation Exchange Capacity (CEC)

- Soils high in **clay** and **organic matter** (heavier soils) have the **highest cation exchange capacities**
- while **sandy soils** (lighter soils) with **little organic** matter have the **lowest capacities (CEC)**
- **CEC values will range from a low of 5 to a high of 40.**
- **Values between 12 and 25 are generally considered good**

Cation Exchange Capacity (CEC)

- The CEC of your soil will determine the frequency of application of nutrients.
  - If your soils is predominately sandy you will need to fertilize in smaller increments and more frequently (time release best)
  - However if you have a soil with a high CEC (Clay and OM) you will need to fertilize less frequently and in larger amounts.

CEC of dahlia members soil



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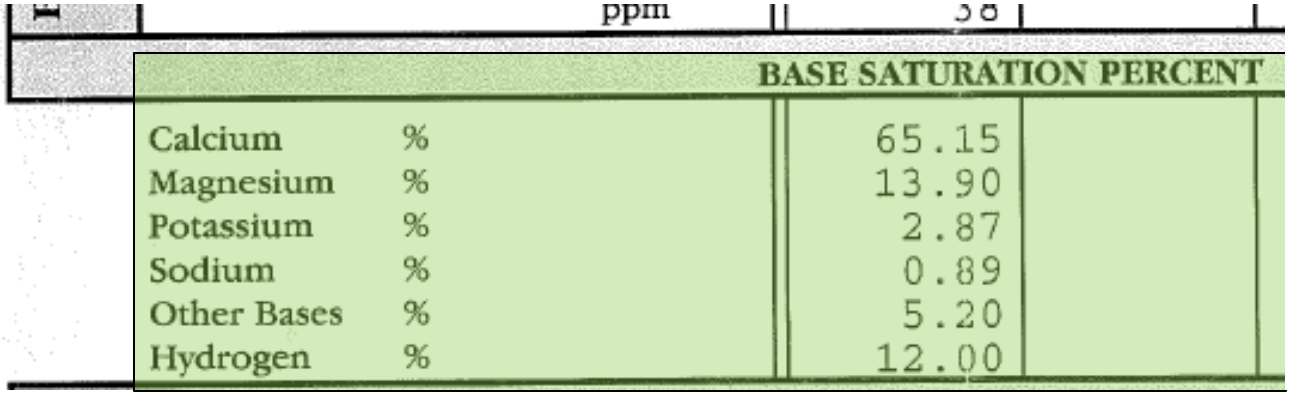
5) Base Saturation—Ideal soil

- The percentage of the CEC that a particular cation occupies on a soil particle is also known as the base saturation percentage (% of Exchangeable Bases on MSU Soil Report)
- The ideal soil's CEC is saturated to about
  - 60-80% (65%) Calcium
  - 11-20% (15%) Magnesium
  - 1-4% (4%) Potassium
  - 1-5% Sodium
  - ~ 5% other bases
  - ~ 8% hydrogen

5. Base Saturation



	ppm	38	
		BASE SATURATION PERCENT	
Calcium	%	65.15	
Magnesium	%	13.90	
Potassium	%	2.87	
Sodium	%	0.89	
Other Bases	%	5.20	
Hydrogen	%	12.00	

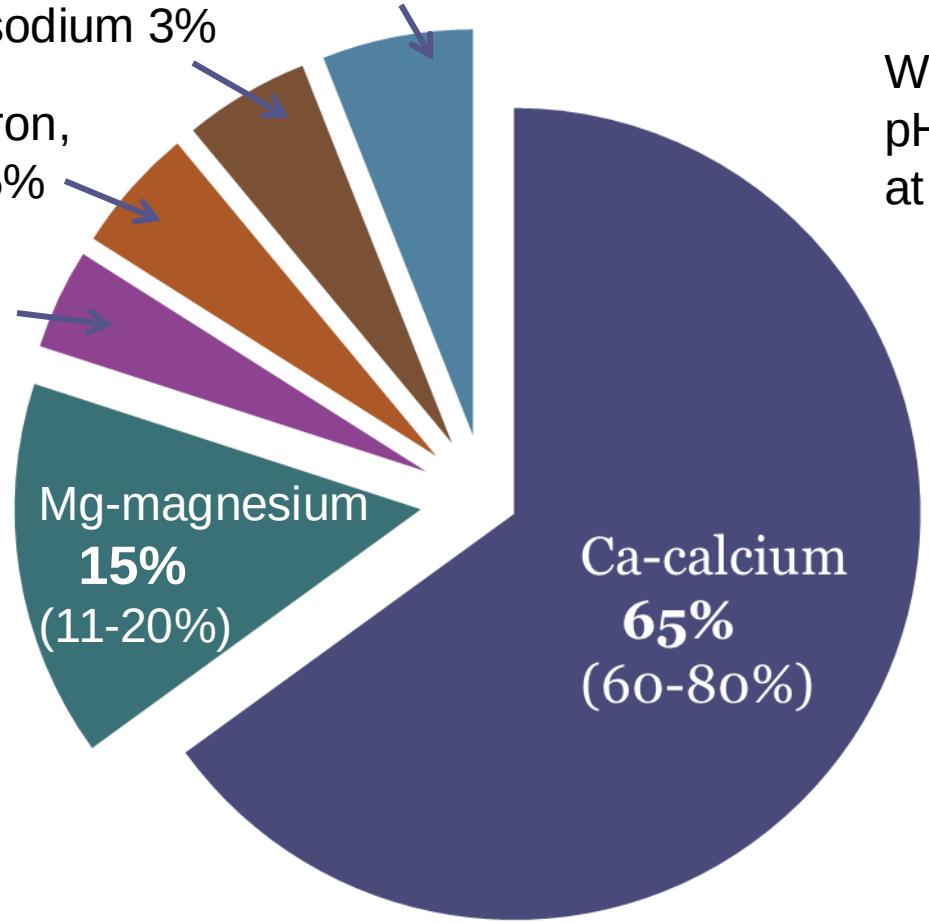
Ideal base saturation (100%)

H- exchangeable hydrogen 8%

Na-sodium 3%

Copper, zinc, iron, manganese- 5%

K- potassium **4%** (1-4%)



When ideal is met soil will pH will automatically stabilize at or around 6.4

Clay or Humus particle

Base Saturation—Ideal soil

- Your soil test will report the parts per million (ppm) and percent bases (%) for first three on this list- calcium, magnesium and potassium.
- Ideally your values should fall within these ranges, if not you can adjust your fertilization program to bring the soil back to the ideal range.

- If one of these elements falls above or below the desired range, the plants will be unable to take up that element resulting in a deficiency.
  - Ie. If calcium fell below the ideal range the uptake of calcium would be reduced
  - Ie. If the potassium level increased 10% then the uptake of calcium and magnesium could be reduced.
- This deficiency will express itself as slower growth or chlorosis (yellow leaves or yellow regions between leaf veins).

- Without knowing the levels of these nutrients (soil test) indiscriminate application of these minerals could lead to a nutrient imbalance

Base Saturation: Dahlia Members Soil

	Wilson	Keith	Pam	Sherree	Jim	Recommended
Calcium	73%	65%	76%	78.4	63.8	60-70%
Magnesium	13%	14%	17%	15.0	21.3	11-20%
Potassium	2%	3%	3%	2.2	10.1	1-4%
Sodium	0.7%	0.90%	0.47%	.64	1.2	0.5-3%
other bases		5.2%	4.2%	4	3.6	5%
Hydrogen	6%	12%	0	0	0	8%

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6. Soil nutrient levels

Phosphorus, potassium, magnesium

MSU Soil Test.com - Personalized Recommendations for Your Lawn and ... Page 1 of 2

MICHIGAN STATE UNIVERSITY | Extension MSU Soil Test.com

Soil Test (#F84257) Report for Dave Walton – 110813 Dahlia (crop: Flowers, Perennials)

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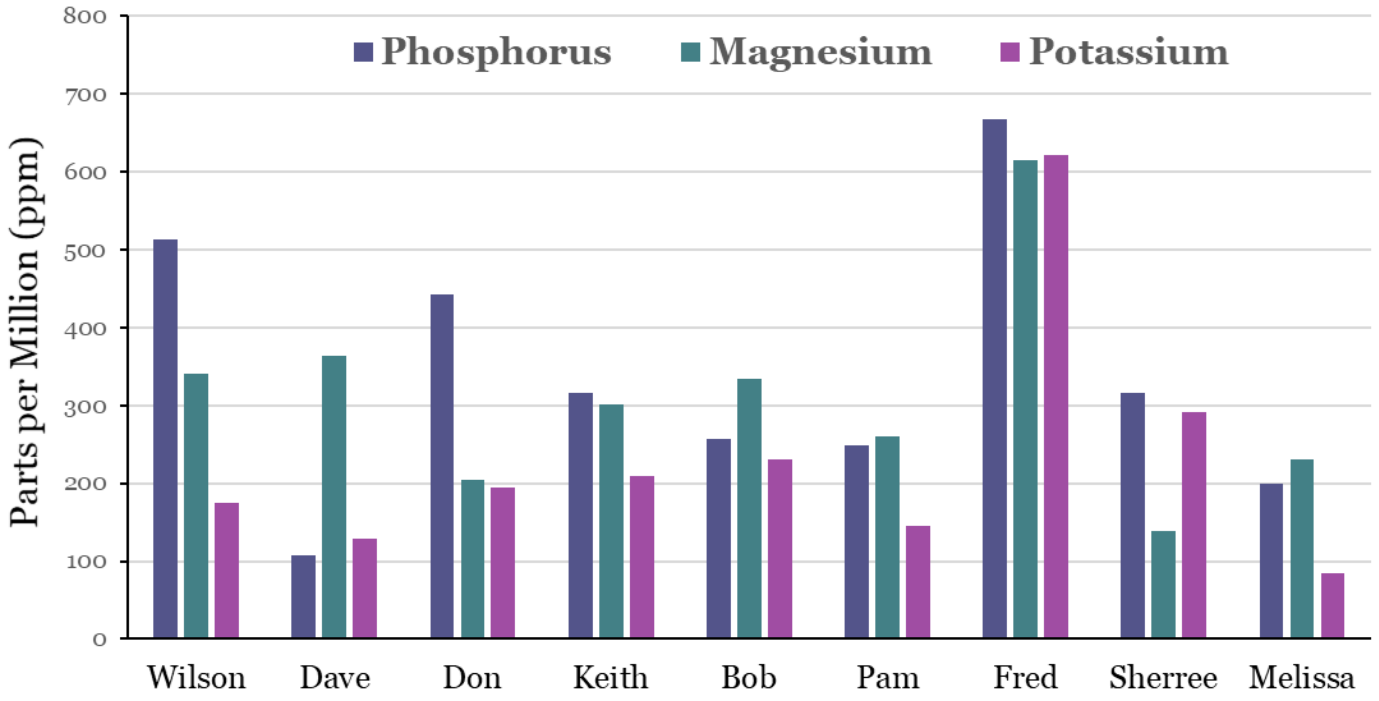
CEC	14.626 meq/100 g			
Soil type	MINERAL , Sandy loam			
Soil pH	7.3			
Lime index	0			
Organic Matter	6.5 %			

- Phosphorus (P)
  - Very important in the formation of flowers and fruits
  - Aids in withstanding stress
  - Builds up in soil
- Potassium (K)
  - Growth of supportive parts of plants such as stalks and stems and tubers; fights disease
  - Builds up in soil
- Magnesium (Mg)
  - Essential for formation of chlorophyll in plants; responsible for green color

Dahlia members soils

- Generally levels all WAY above optimum levels!!
  - Phosphorus – 8-20 ppm
  - Magnesium – 27-70 ppm
  - Potassium – 38-80 ppm



- The main symptom of excessive phosphorus in soil is **stunted plant growth**.
- High P interferes with N absorption.
- Also there may be symptoms of deficiencies of zinc, iron, cobalt or calcium, because the P has locked up these nutrients.

Minor Elements—optional test (recommended)

Minor Element	Wilson	Keith	Bob	Pam	Sherree	Jim	Recommended range (p.p.m.)
Aluminum	187	548		335	143	251	<1000
Boron	1.09	1.2	**0.08**	0.67	1.32	1.68	0.5-2.0
Copper	2.68	**4.9**	**0.03**	1.05	5.11	1.53	1.6-3.0
Iron	201	66	**2.13**	**1.69**	177	266	>50
Manganese	26	32	**3.64**	**57**	32	32	15-30
Zinc	**57.25**	**44.5**	**.03**	6.37	**14.2**	**20.9**	3.1-6.0

MSU soil test recommendations

Follow Your Personalized Recommendations

Important: Always apply fertilizers according to label instructions

Your soil test indicates you need to apply 0.1 lb. Nitrogen (N)/100 sq. feet, 0 lb. phosphate (P_2O_5)/100 sq. feet and 0.2 lb. potassium (K_20)/100 sq. feet to meet recommendations. Below you will find some examples of fertilizers that could be used. After you select a fertilizer, use the fertilizer calculator to determine how much phosphorus and potassium the fertilizer you selected will apply.

Must-Read Tipsheets

- **Soil pH**
  http://www.msusoiltest.com/files/soil_ph.pdf
- **Clean Up Fertilizer to Protect Water**
  http://www.bephosphorussmart.msu.edu/LinkClick.aspx?fileticket=vn2YWhtZ8gw%3d&tabid=60
- **Fertilizer Basics**
  http://www.msusoiltest.com/files/fertilizer_basics_rebecca_finnera
- **Fertilizer Application Methods and Placement**
  http://www.msusoiltest.com/files/fertilizer_application_methods_a
- *Other Web Links...*
  http://www.msusoiltest.com/links

The following are typical fertilizers that can be used to satisfy the nutrient requirements of your garden. If the particular fertilizer is not available, choose a fertilizer close to the prescribed fertilizer and use the Fertilizer Calculator to determine how much nitrogen, phosphorus and potassium the fertilizer you choose applies.

Desired fertilizer ratio - 1:0:3

	Analysis	Fertilizer Rate (lb/100 ft²)
Option 1	12-0-42	3/4
Option 2	5-0-15	1 1/2
Option 3	0.7-0-2	11

Option 1. Manufactured Fertilizer: Apply 12-0-42 fertilizer at 2 pounds per 100 sq ft when growth begins in spring and work or water into soil.

Option 1 Characteristics: More readily available for plant uptake, more concentrated form of nutrients, generally less expensive per pound of fertilizer nutrient.

Fertilizing Recommendations for Dahlias

- Assuming pH, phosphorus, potassium, calcium, magnesium, and minor elements are in the optimum range:
  - Use a fertilizer that maintains a ratio of 3-1-4 (NPK)
  - a fertilizer with a NPK ratio of 18-6-12/1000 sq. ft. is recommended for dahlias
  - This will provide the high N and K requirements of dahlias and keep P from building up in soil

The H3A Soil Extractant Test- available from Dairy Doo Soil Test

- Examines the **biological activity** of your soil
- This extract is designed to mimic organic acids produced by living plant root systems.
- These organic acids increase nutrient availability in the root zone.

- The Soil Health Calculation
  - uses the **CO2 Burst**, **Organic Carbon**, **Organic Nitrogen**, and the **C/N ratio** to generate the **soil health number**.
  - This calculation looks at the balance of soil carbon and nitrogen and their **relationship to microbial activity.**
  - This number represents the overall health of your system.
  - Soil values will range from 0 to 25 (my soil was 16)
    - A soil with a value below 7 would be considered low.
    - Should keep track of value over time to see how your soils biological health is doing

Summary Comments

- Should I get a soil test?
  - If you are unable to grow dahlias at the quality you want it is possible that some aspect of your soil chemistry is outside of the recommended levels
- If you are satisfied with your dahlia plants, a soil test will allow you to see where you stand and/or ways to improve your soil
- Remember, based on comparisons to several dahlia growers plots, there is room for some variation—don't panic if your pH seems to high
- A H3A Soil Extractant Test is important to see how your biological activity doing
- If you decide to have your soil tested, I hope this talk will help you in evaluating your results

Good Soil Results in Great Dahlias