Bringing Knowledge to Life

Cover Crops and Phosphorus Speciation in Ohio

Why so much SRP in Surface Water?

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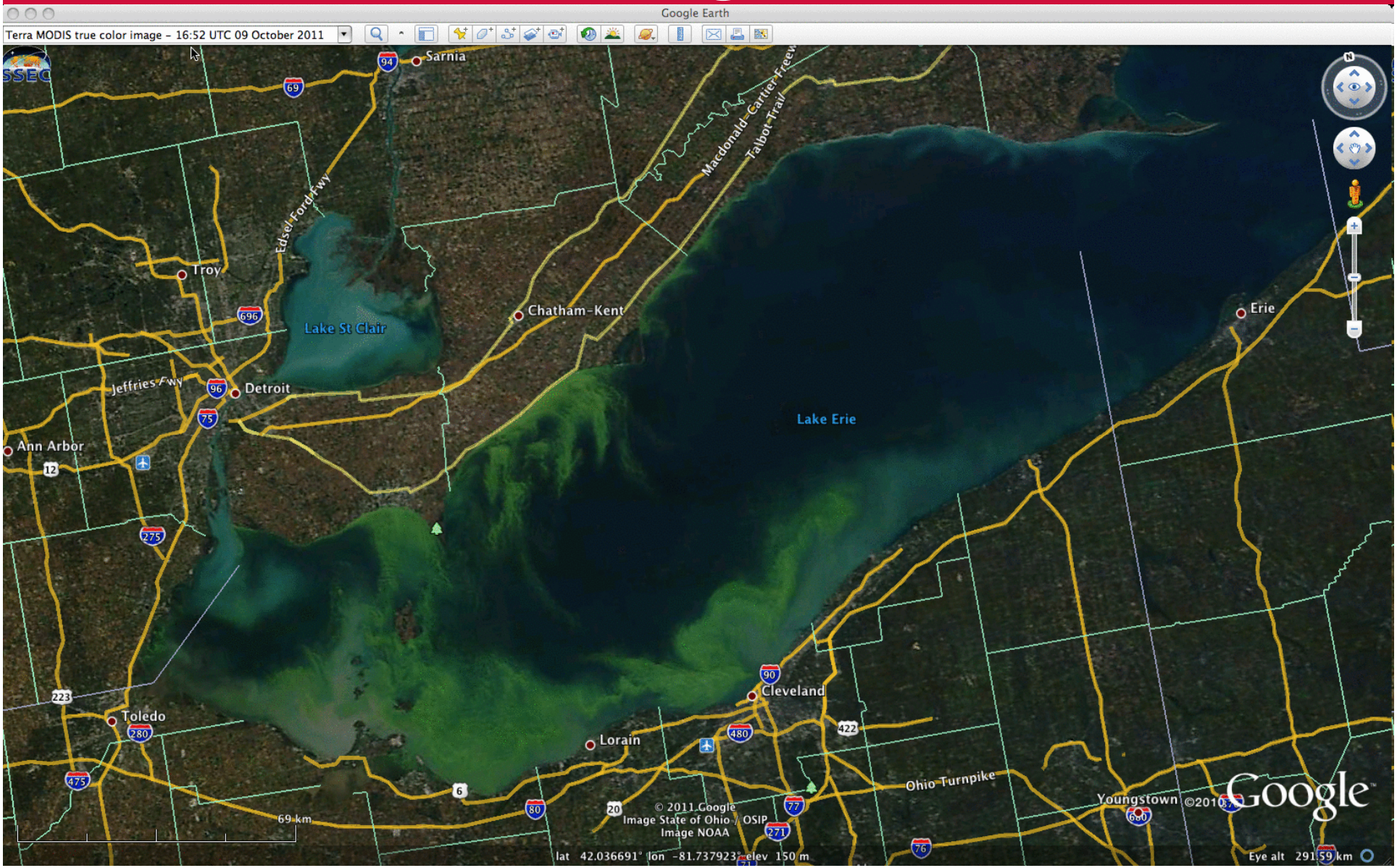
THE OHIO STATE UNIVERSITY EXTENSION

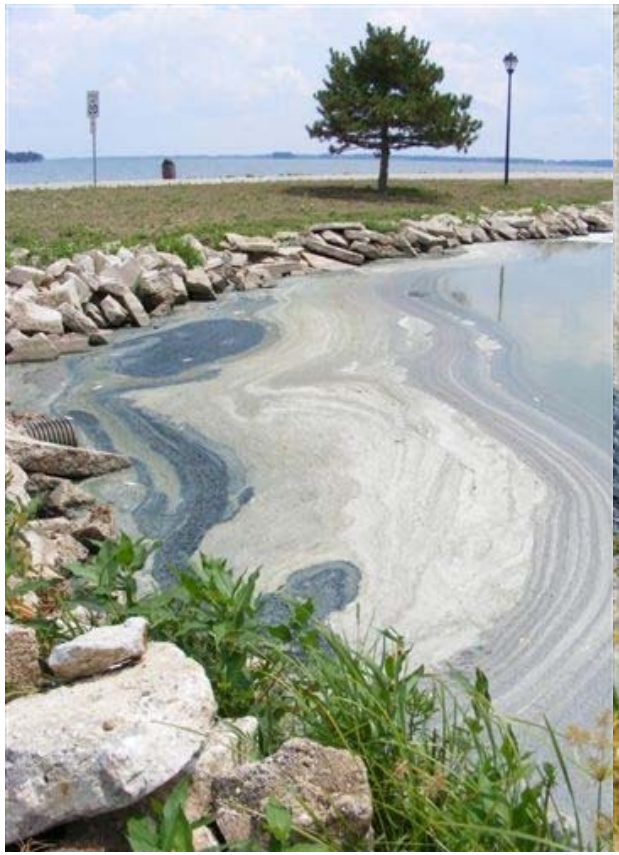
10/09/11 Image Lake Erie

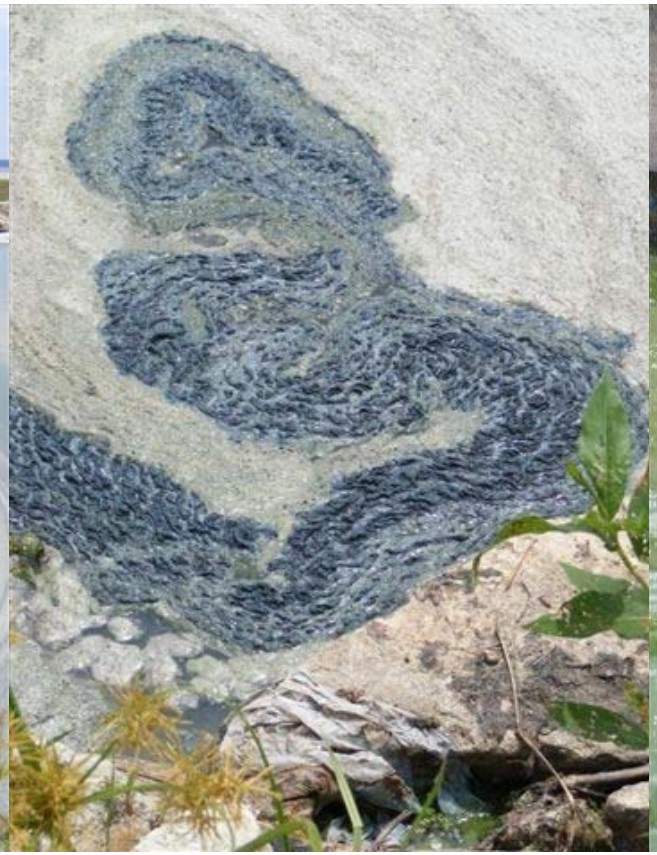


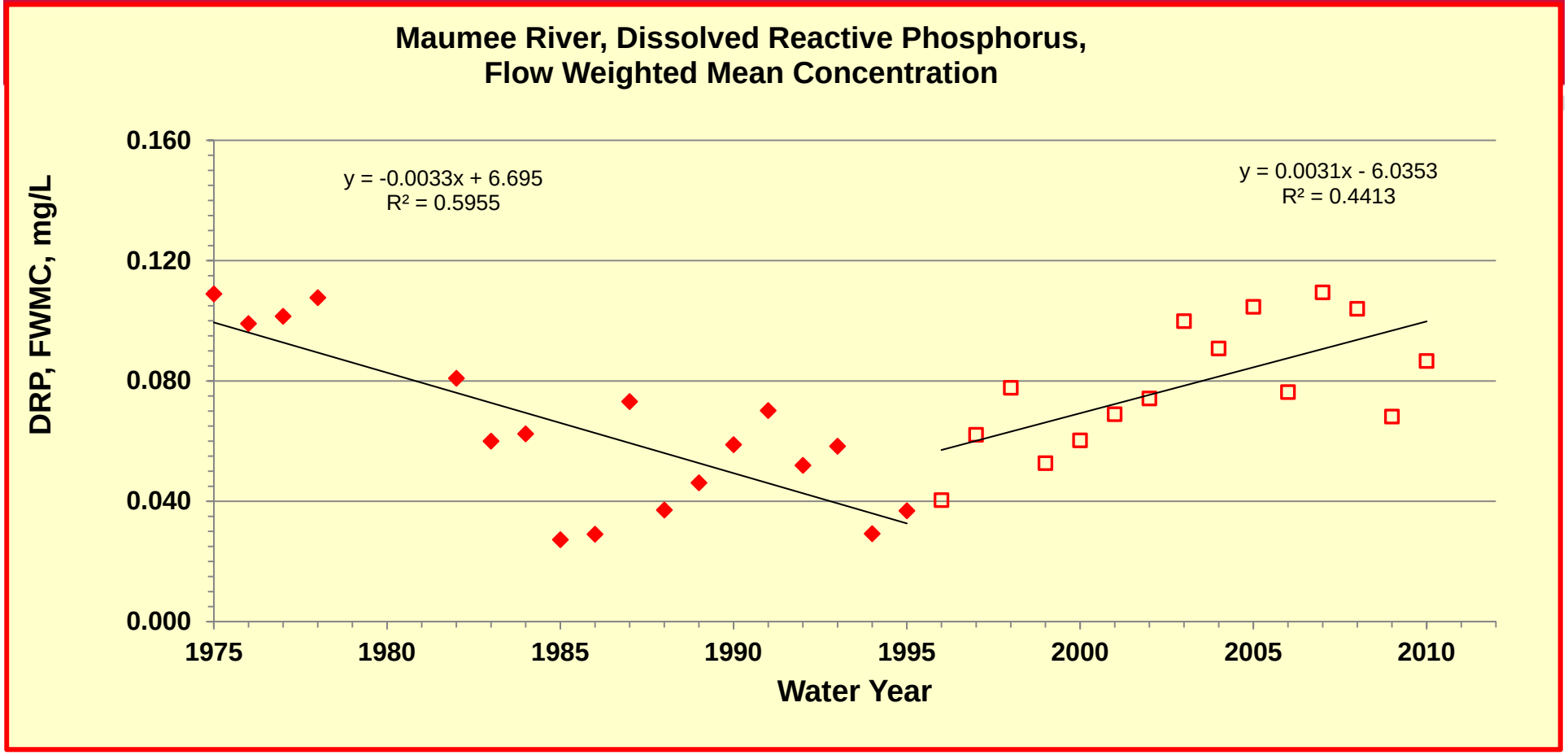
July, 2011

Source:http://www.glerl.noaa.gov/res/Centers/HABS/graphics/wle_hab2_%20072211.jpg

Grand Lake St. Marys 2010

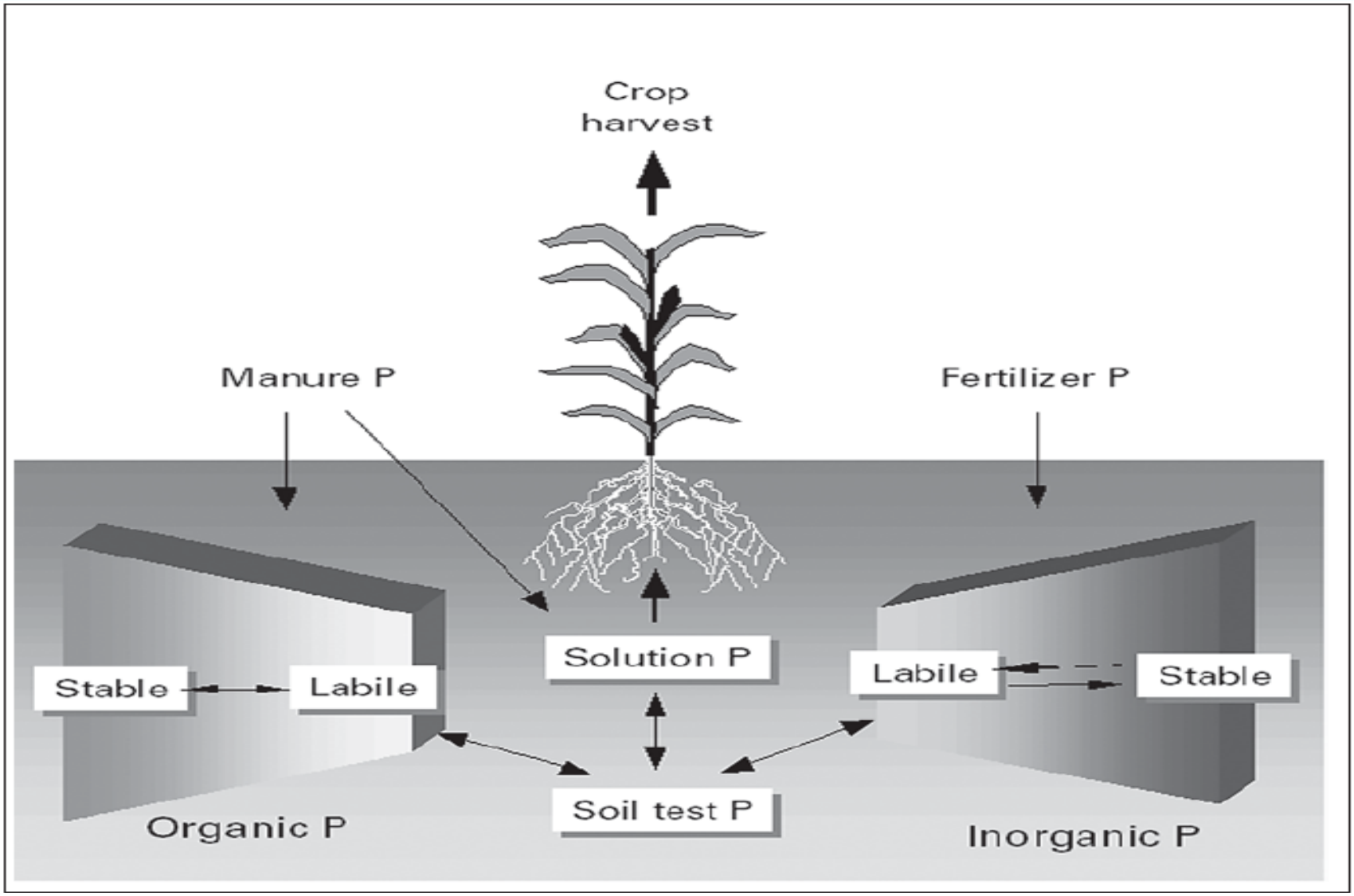




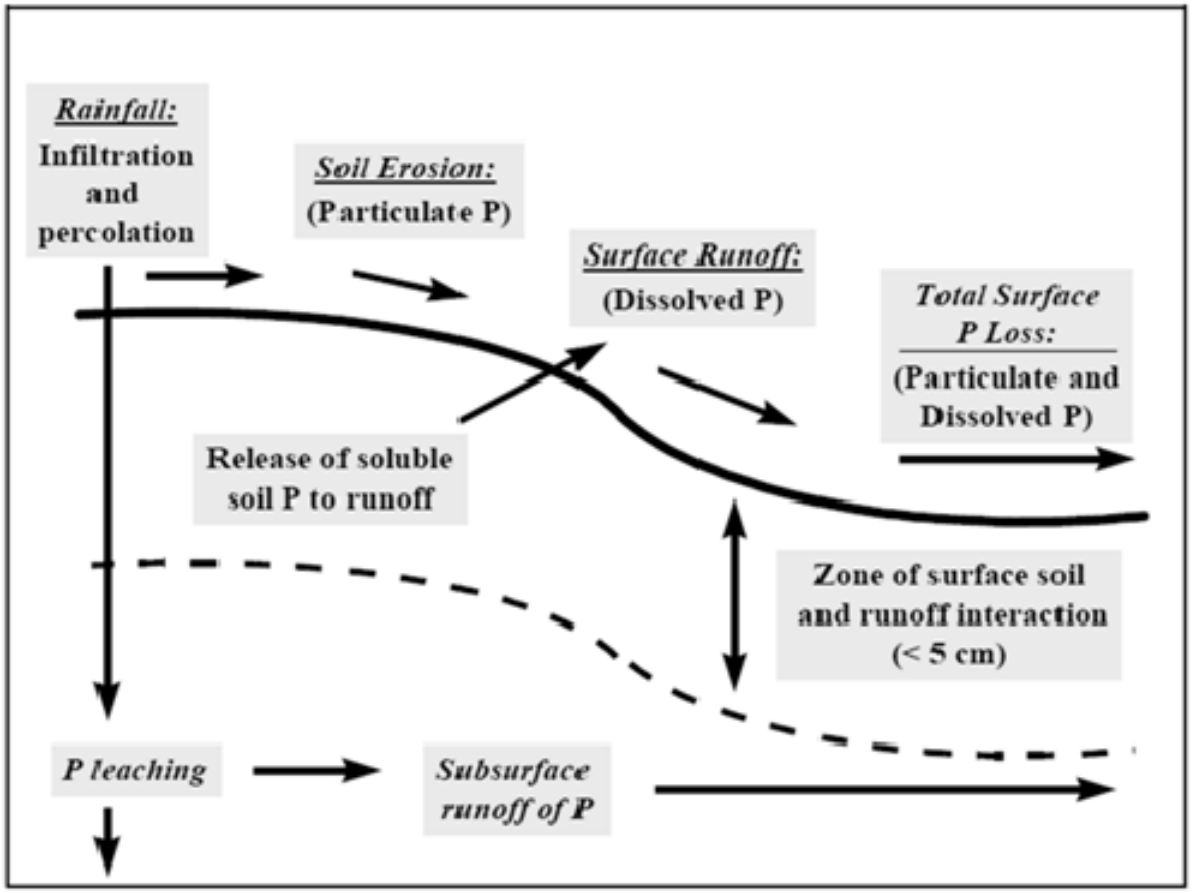


Source: Hiedelberg University

Phosphorus in Crop Production

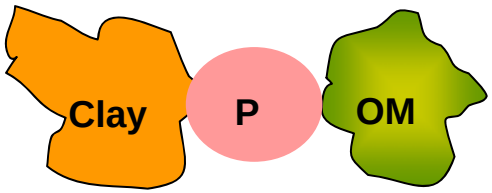


Phosphorus Losses to the Environment

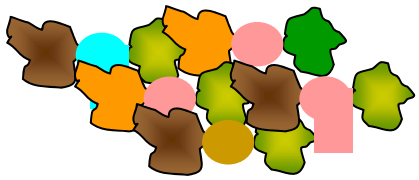


P stabilizes the OM and forms a bridge to the clay.

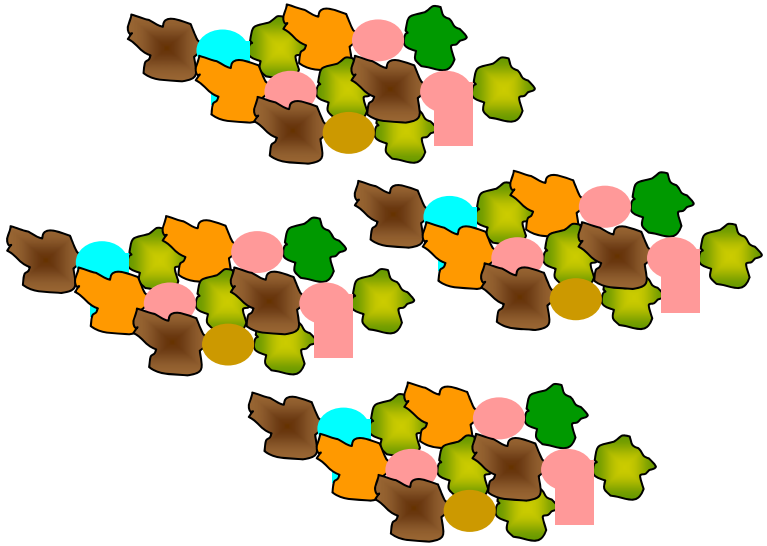
Our current P use efficiency is 10-25-50%.



Clay-P-OM



$(Clay\text{-}P\text{-}OM)_x$



$((Clay\text{-}P\text{-}OM)_x)_y$

Phosphorus Speication: How Soil P is tied up

- Microbial – P_o P_o -Organic P
- Soluble Reactive (SRP) P_i P_i -Inorganic P
- Exchangeable (EP) P_o Active Carbon
- Ca^{2+} /Mg^{2+} Calcium/Magnesium
- Fe^{3+} /Al^{3+} Iron/Aluminum
- Res P_o Residual P_o -Humus
- Total P = All P_o + All P_i
- Murphy & Riley Standard P Extraction(1962)

Phosphorus Speciation

Oxidized State	Reduced State
Iron (III) - Fe^{3+} (Ferric Fe) Yellow-Red	Iron (II) - Fe^{2+} (Ferrous Fe) Yellow-Grey
Manganese – MN^{4+} Pinkish Color	Manganese - MN^{2+} Grey-Black
Copper – Cu^{3+} Light Blue	Copper - Cu^{2+} Green

SRP in Surface Water

Two Key factors:

a) Soil P concentration

b) Transport Factor

Soil P concentration

* Transport Factor

= Pounds of P Lost to Surface Water

Cover Crops versus Control

SRP	EP	CaP	FeP	Res P	Total P
Cover Crops					
0.34b	**1.23a**	21.2a	25.7a	**147.7b**	**196.1b**
	8.8X				
Control					
1.42a	**0.14b**	18.0b	27.1b	**162.8a**	**209.5a**
4.2X				**1.1X**	**1.07**

Cover crops had significantly lower soil concentration of P in the SRP (4.2x less), Res P, and Total P but much higher EP (8.8X), CaP, and FeP.

Cover Crops vs Control Stratification

SRP	EP	CaP	FeP	Res P	Total P
Cover Crops					
0.4b	**61.7a**	1.6a	1.4a	1.5b	**2.0a**
	9.1X				**1.25X**
Control					
1.8a	**6.8b**	1.4a	1.4a	1.6a	**1.6b**
4.5X					

Cover crops (Red clover) had significantly lower soil stratification of P in the SRP fraction but significantly higher EP and TP fractions.

Long Term No-Till vs. Rotational Tillage

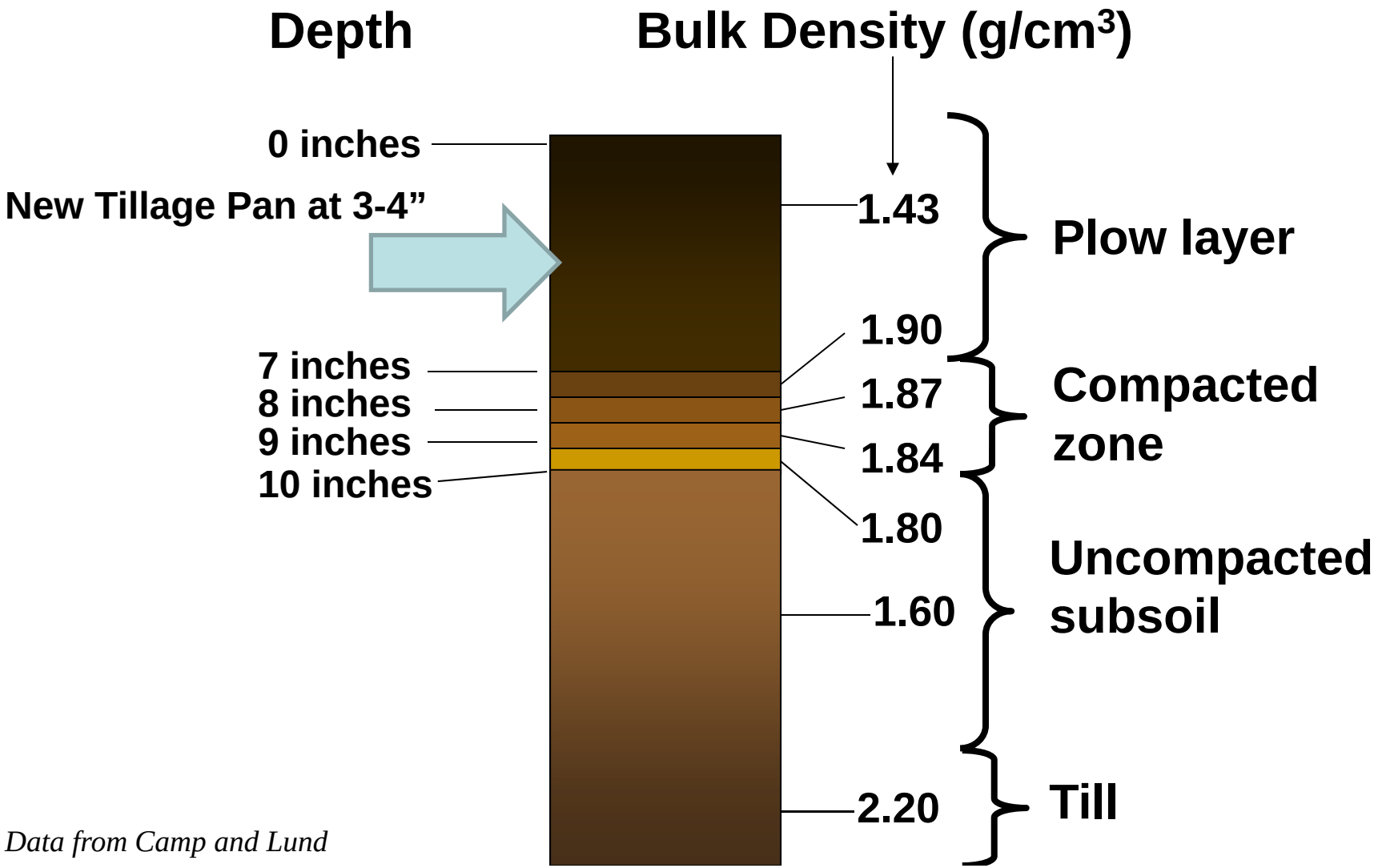
Both Fields are a Corn/Soybean Rotation

These pictures are of a newly emerging corn crop

NoTill soybeans then StripTill Corn

NoTill Soybeans then Tilled corn

Bulk Density and Compaction



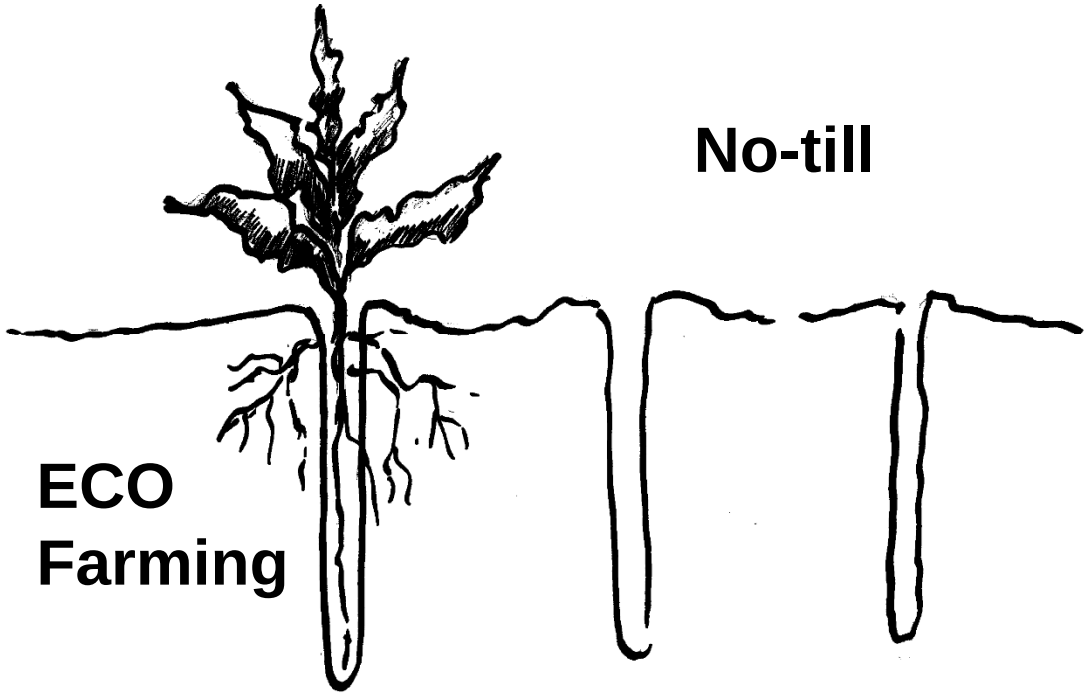
Data from Camp and Lund

Benefits of Cover Crops

- Increase water infiltration – Move SRP_i down into soil profile.
- Decrease bulk density and increase pore space for both air and water – Less saturated soils.
- Increase soil organic matter content which improves soil structure and holds P tighter

  $SRP_i < EP_o$ and $FeP_i < Res\ P_o$

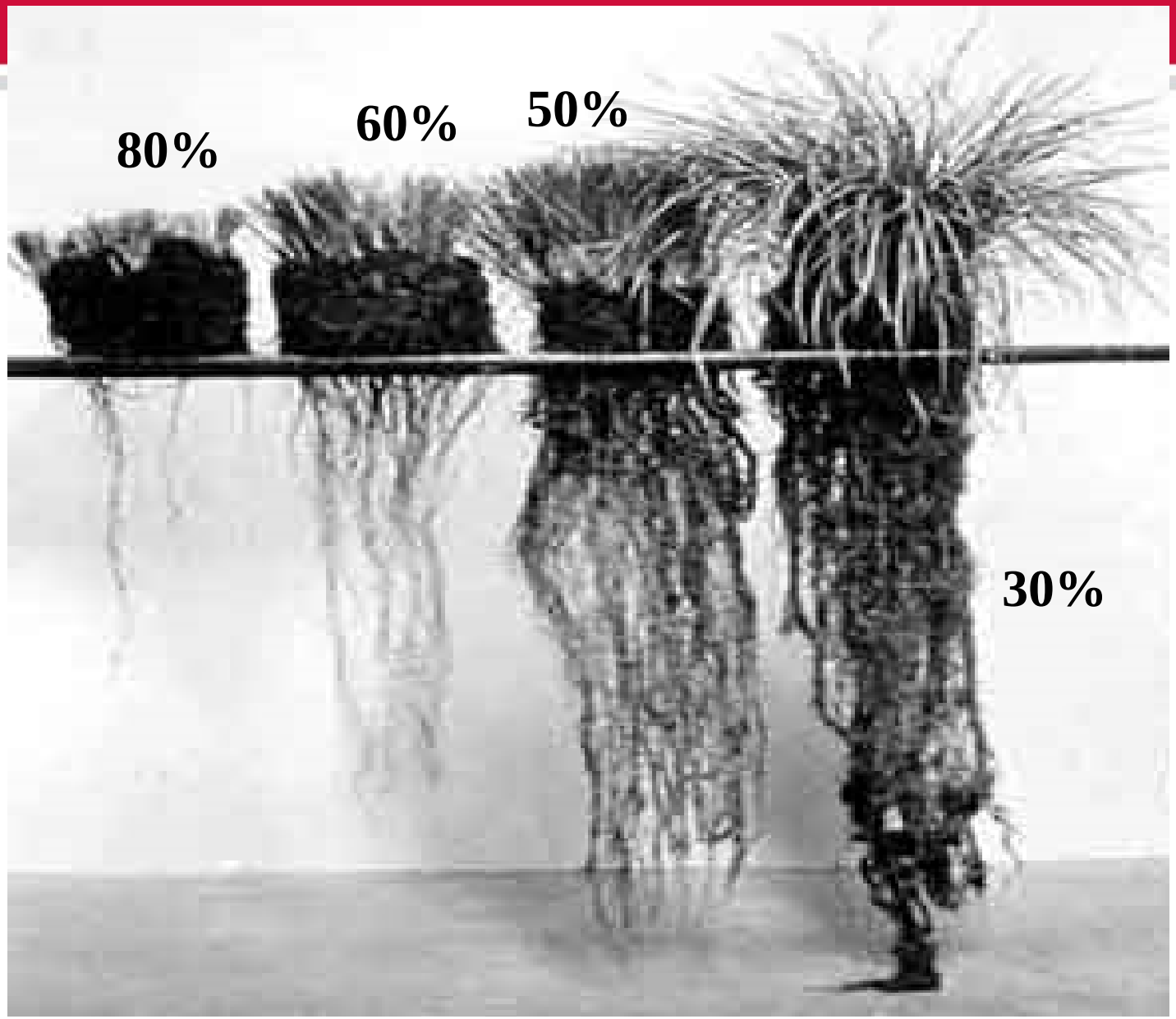
N0-TILL creates macropores



ECO Farming & live roots acts like a biological valve to absorb N and P.

Illustrated by Cheryl Bolinger-McKirnan & Jim Hoorman

Managing plant roots affects nutrient recycling



Additional Facts about FeP

- FeP_i Mediated or changed by soil microbes (Hedley, 1982)
- FeP_i can be reservoir of P when soil P is low (Kuo, 2003; Zhang 1997) and is considered to be plant available (Zhang, 1997).
- At high fertilization, SRP_i can easily be converted to FeP_i (Kuo, 2003; Zhang, 1997).

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