



Western Ag Innovations

Applying Research Solutions to Agriculture and the Environment

An introduction to the PRS (Plant Root Simulator)TM-probe

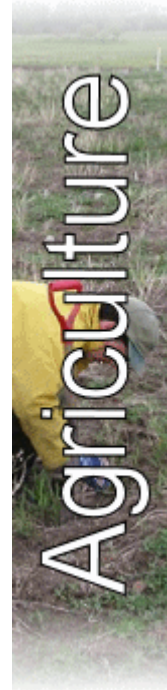


Nutrient Management in Organic Cropping Systems

OSU CSS 599

Overview

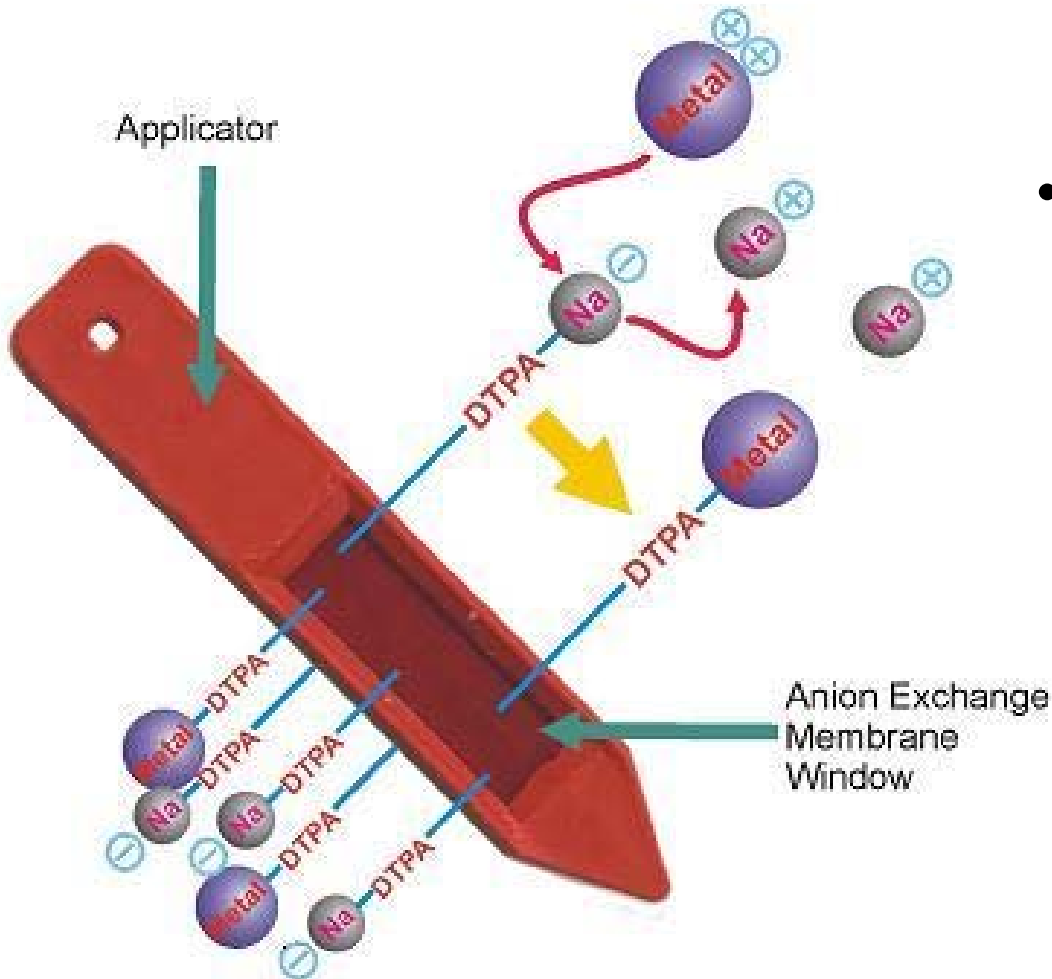
- Ion Exchange Resins
 - Environmental factors
 - PRS Probes vs. Conventional Soil Tests
- Types of Burials
- Soil Duration Burial
- Root Competition
- PRS- Probes Analysis
- PRS Nutrient Forecaster™
- Closing Statement



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PRS Probes™ - Ion Exchange Resins

- Measure ion fluxes in the soil as an indication of soil fertility
- Nutrient supply rate to an ion sink, expressed as the amount of nutrient adsorbed per surface area of IER during the duration of burial (μmol or μg per cm^2 per time)



Source: Dr. Jason Conder

**$\text{NO}_3\text{-N}$, $\text{NH}_4\text{-N}$,
 $\text{H}_2\text{PO}_4\text{-P}$, K , Ca , $\text{SO}_4\text{-S}$,
 Al , Fe , Mn , Cu , Zn ,
 B(OH)-B , Cl , Na , Pb ,
and Mg .**

Ion exchange resin integrate all of the principal environmental factors affecting nutrient uptake by plants regardless of soil type:

- Soil moisture**
- Soil temperature**
- Mineralization and immobilization**
- Buffer power**
- Dissolution**
- Ion diffusion from great distance**
- Free ion activities**

Ion Exchange Membranes

- Simulate root uptake of nutrient ions (simultaneous extraction of all the major nutrients elements)
- Plant root exchange HCO_3^- and H^+ for nutrients (*in situ* measurement over time)
- Both are continuous sink for nutrients
- Creating diffusion gradient
- Correlates well w/ plant uptake under a variety of conditions (index of relative nutrient bioavailability)

Conventional Soil Tests

- Based on relationships
- Index rather than a direct measure of plant available nutrients
- Calibrated in order to make a fertilizer recommendation



Types of Burials when using PRS™ Probes

- in the field
- in the lab
- in growth chamber
- in saturated pastes
- under crop residues or
- in the LFH layer in forest soils

Soil Burial Duration when using PRS™ Probes

Short Duration (1 -24 hours) Soil burial

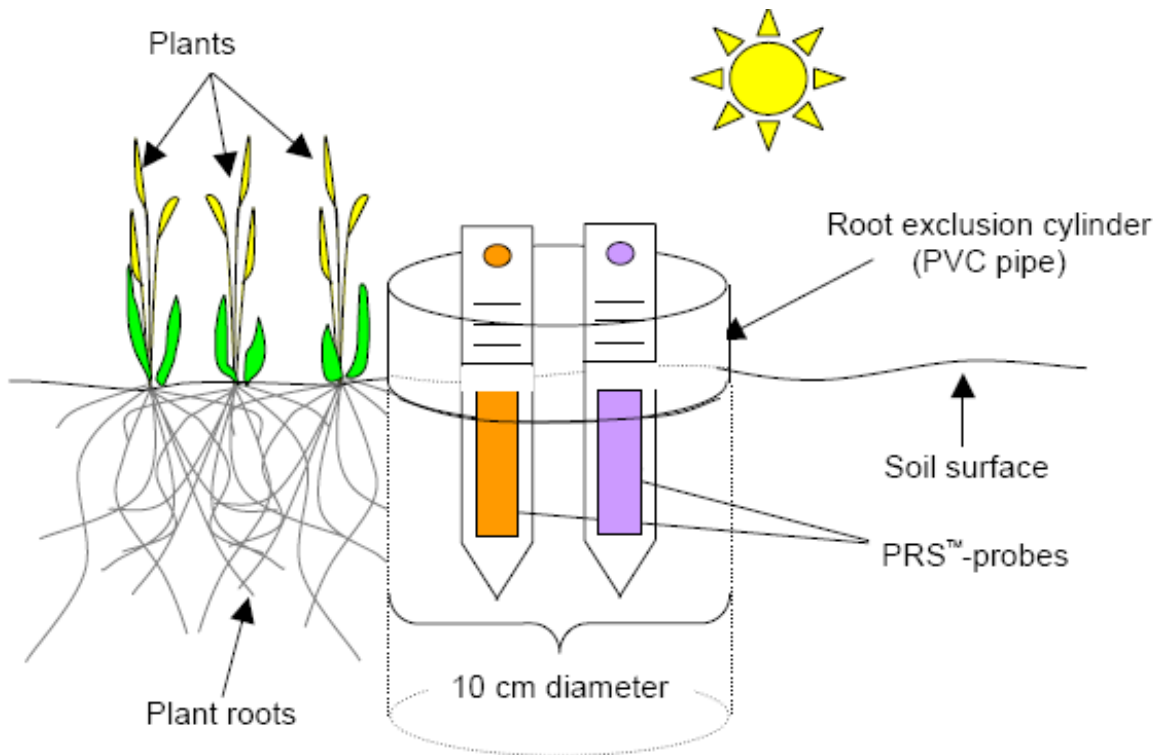
Extended Duration (multiple weeks) Soil Burial

- Soil Contact
- Temperature
- Moisture

Root Competition

1. Roots are a stronger sink for nutrients than the PRS probes
2. Root exclusion cylinder for isolating the PRS probes from plant root competition

3. This will measure the gross nutrient supply rate rather than the net nutrient supply rate (nutrients in excess of plant uptake).



Root exclusion cylinder with one PRS probes samples buried within the cylinder.



Figure 1. Root exclusion cylinder used for isolating PRS™-probes from plant root competition during long duration in-field burials.

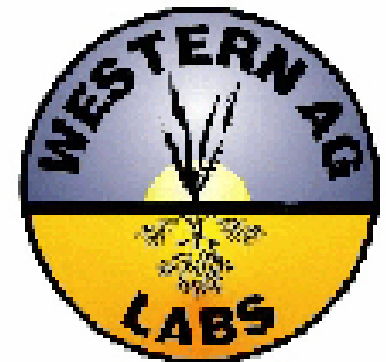
PRS- Probes Analysis

- Elute the PRS probes with 0.5 N HCl and then run the HCl through the autoanalyzer (for N) and/or through the ICP (all other nutrients)
- Regenerate and Rinse
 - Wash 0.5 N HCl
 - Regenerate: 0.5 N NaHCO₃
 - Rise: De-ionized water
 - EDTA treatment for micronutrient metals
 - Soak anion PRS probes in 0.01M EDTA
 - Rinse with de-ionized water

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PRS Nutrient Forecaster™

- Provide fertilizer recommendations to producers
- Input of parameter: soil water content , temperature, texture
- Computer program models soil nutrient supply and crop demand as a function of soil , crop, and environmental conditions
- Predicts the requirement of additional fertilizer nutrient



FIELD SERVICES

Closing Statement – PRS™ Probes

- Easy insertion with minimal soil disturbance; flat structure, adsorptive surface area; direct-contact exchange; easy removal; cleaning, analysis; and reusability
- Usefulness for modeling increased nutrient supply over the growing season given an increased surface area of ion sink
- Replacing an IEM with fresh IEM in the same soil slot provides a reliable index of nutrient availability over time