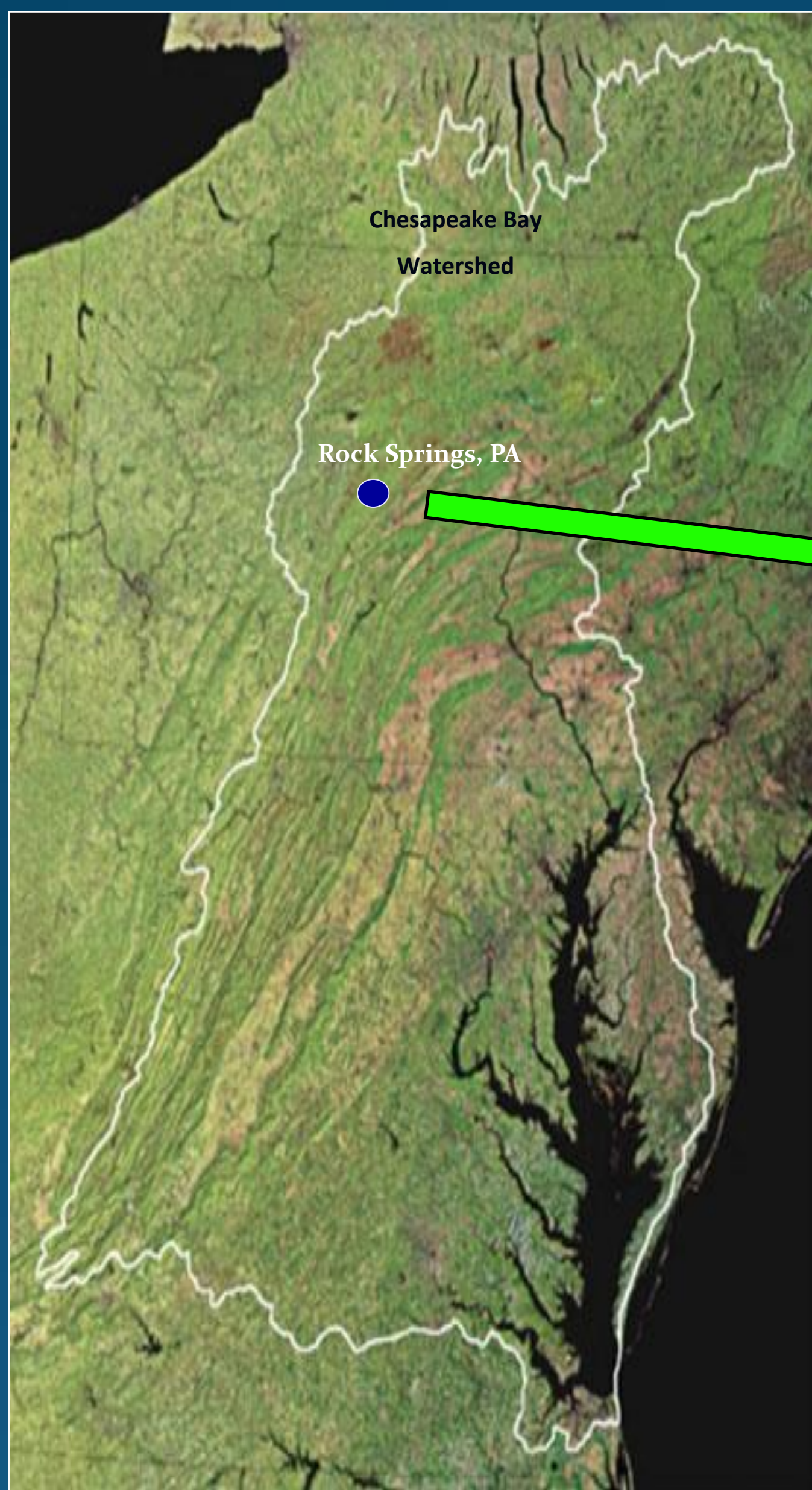


# Effect of Dairy Manure Slurry Application on phosphorus distribution



Keisha N. Johnson<sup>1</sup>, Peter J.A. Kleinman<sup>2</sup>, Doug Beegle<sup>1</sup>,

<sup>1</sup>Pennsylvania State University and <sup>2</sup>USDA-ARS University Park, PA, USA



Study site located on the Pennsylvania State University Russell E. Larson Agricultural Research Center in Rock Springs, PA on a Murrill channery loam (fine-loamy, mixed, semiactive, mesic Typic Hapludults).

## Study Site

## Resin Sheets



Installing resin sheets



Resin sheet recently removed from field



Resin sheet after soil excavated

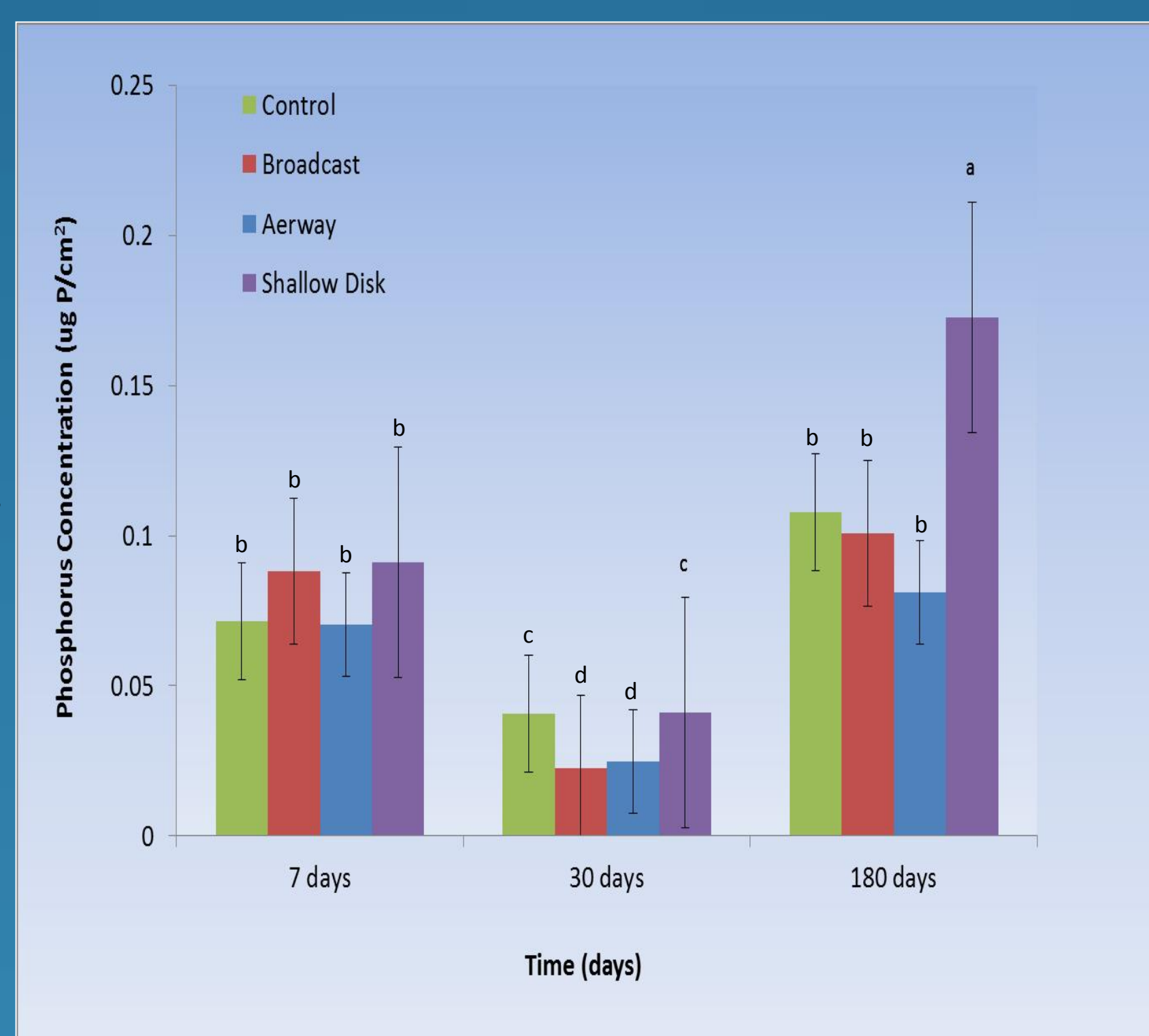


Cutting resin sheets

- Forty eight (30 X 30 cm<sup>2</sup>) 0.5 M bicarbonate-saturated anion exchange membrane resin sheets were installed and buried into excavated soil pits (4 treatments, 4 replications, and three times (7, 30, and 180 days after manure application))
- After 48 hr of equilibration, sheets were removed from soil and taken to lab for analysis
- Each sheet was cut into 100 (3 X 3 cm<sup>2</sup>) strips, placed in 50 mL of 1.0 M hydrochloric acid (HCl) solution, placed on an end over end shaker for 9.5 hours, and analyzed for ICP- dissolved phosphorus

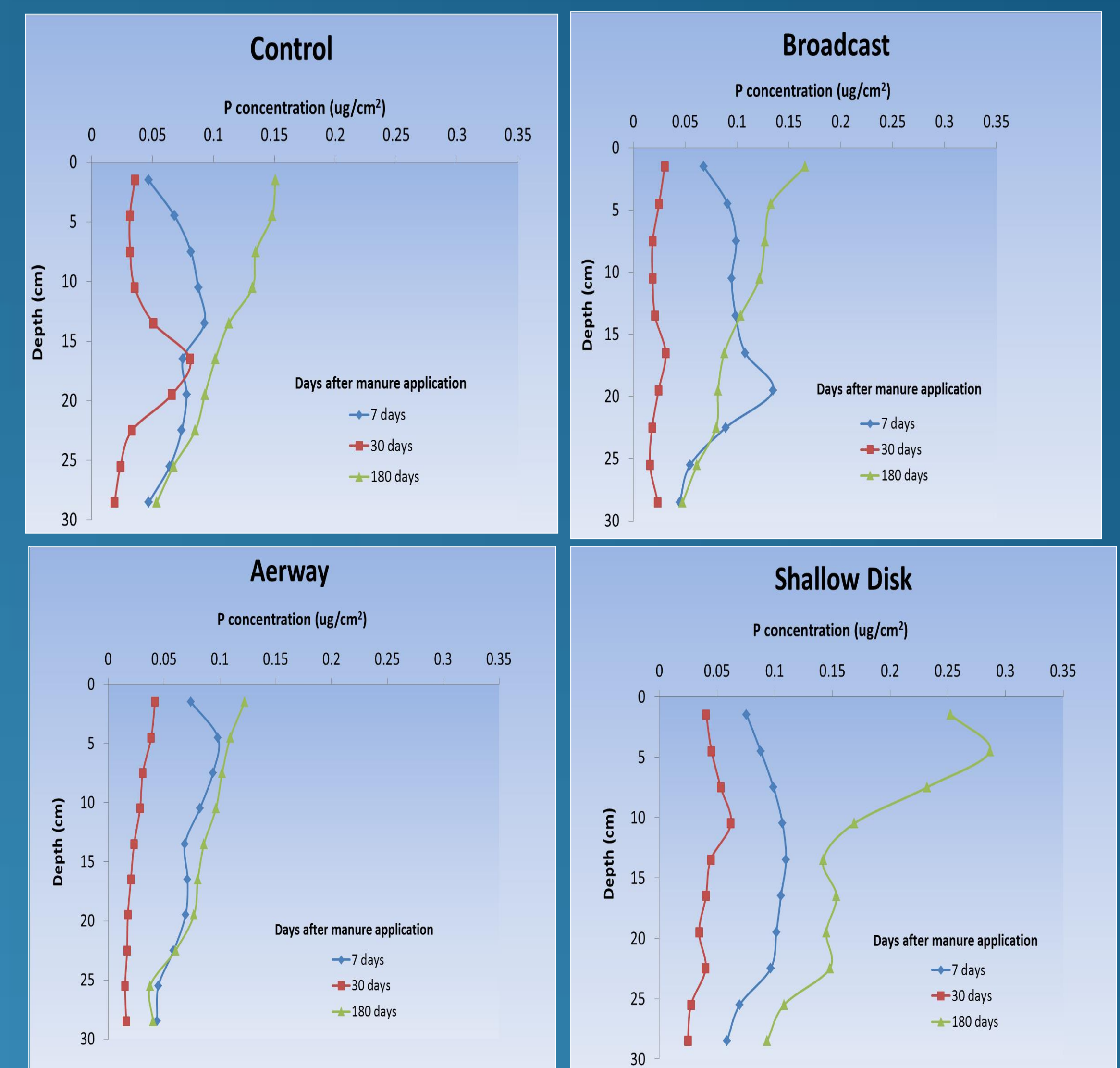
## Summary

Quantifying the dynamics of phosphorus within the soil profile can help in explaining mechanisms by which alternative management practices affect the availability of manure phosphorus to crops and runoff waters. In 2011, we sought to test a method of mapping soil phosphate in a no-till corn production system with different methods of manure application. To track changes in phosphate availability and trends in P movement, observations were made 7 days, 30 days, 180 days after 56,129 L ha<sup>-1</sup> of dairy manure was applied with two low disturbance manure incorporation methods, and conventional broadcasting. Bicarbonate-saturated anion exchange resin sheets were installed to a depth of 30 cm of the soil profile and allowed to equilibrate for 48-hrs. Four observations were obtained per treatment for each observation time. Soil phosphate extracted from sheets during the equilibration periods was mapped within a grid of a maximum resolution of 9 cm<sup>2</sup>. Significant differences in P concentrations were observed 30 and 180 days after manure application with the Shallow Disk consistently yielding higher P concentrations than other treatments.



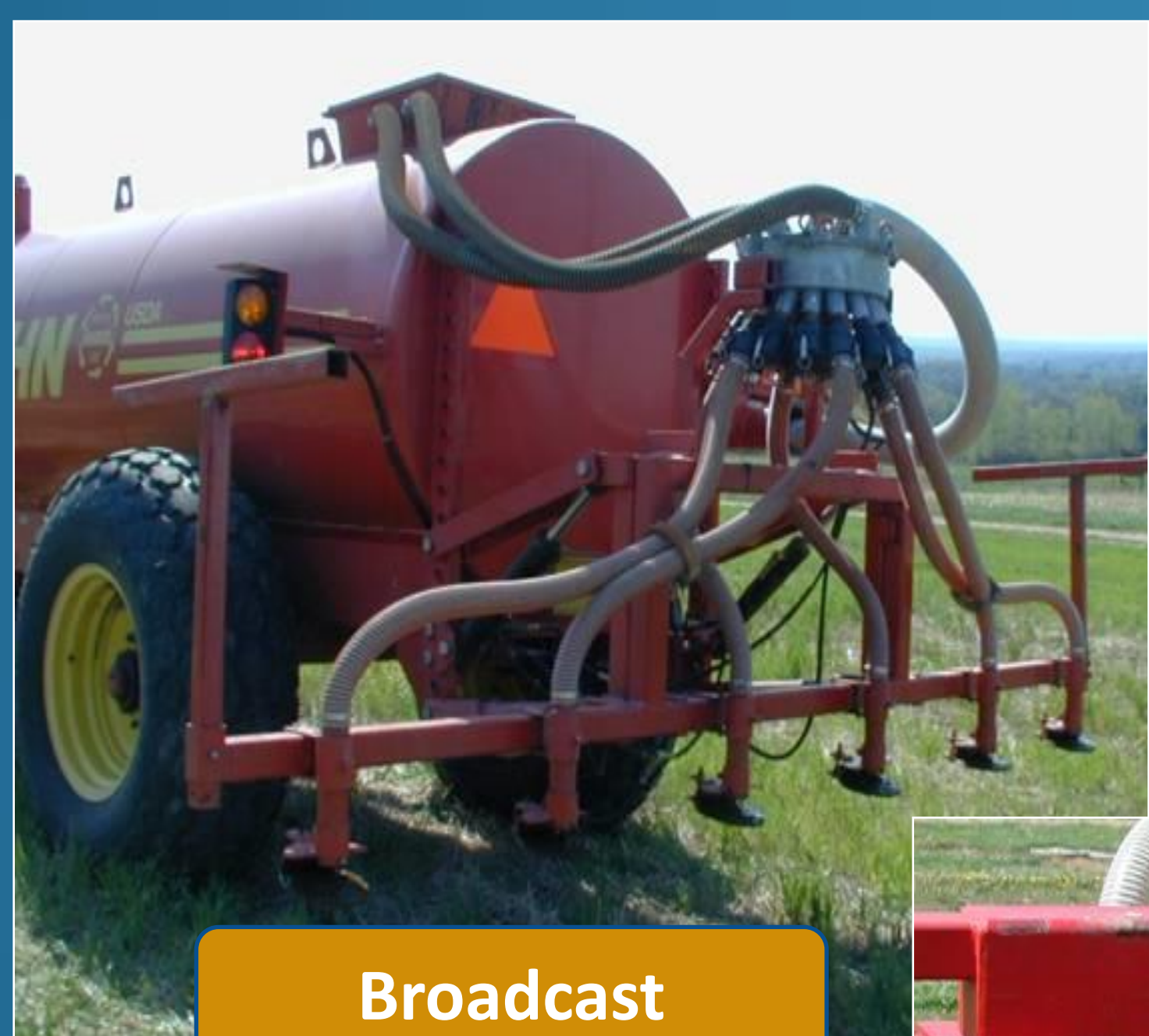
Phosphorus concentration (ug P cm<sup>-2</sup>) determined by extraction with bicarbonate-saturated exchange resin membranes 7, 30, and 180 days after manure application. Significant differences determined by Tukey mean separation test (P < 0.05).

## General Findings

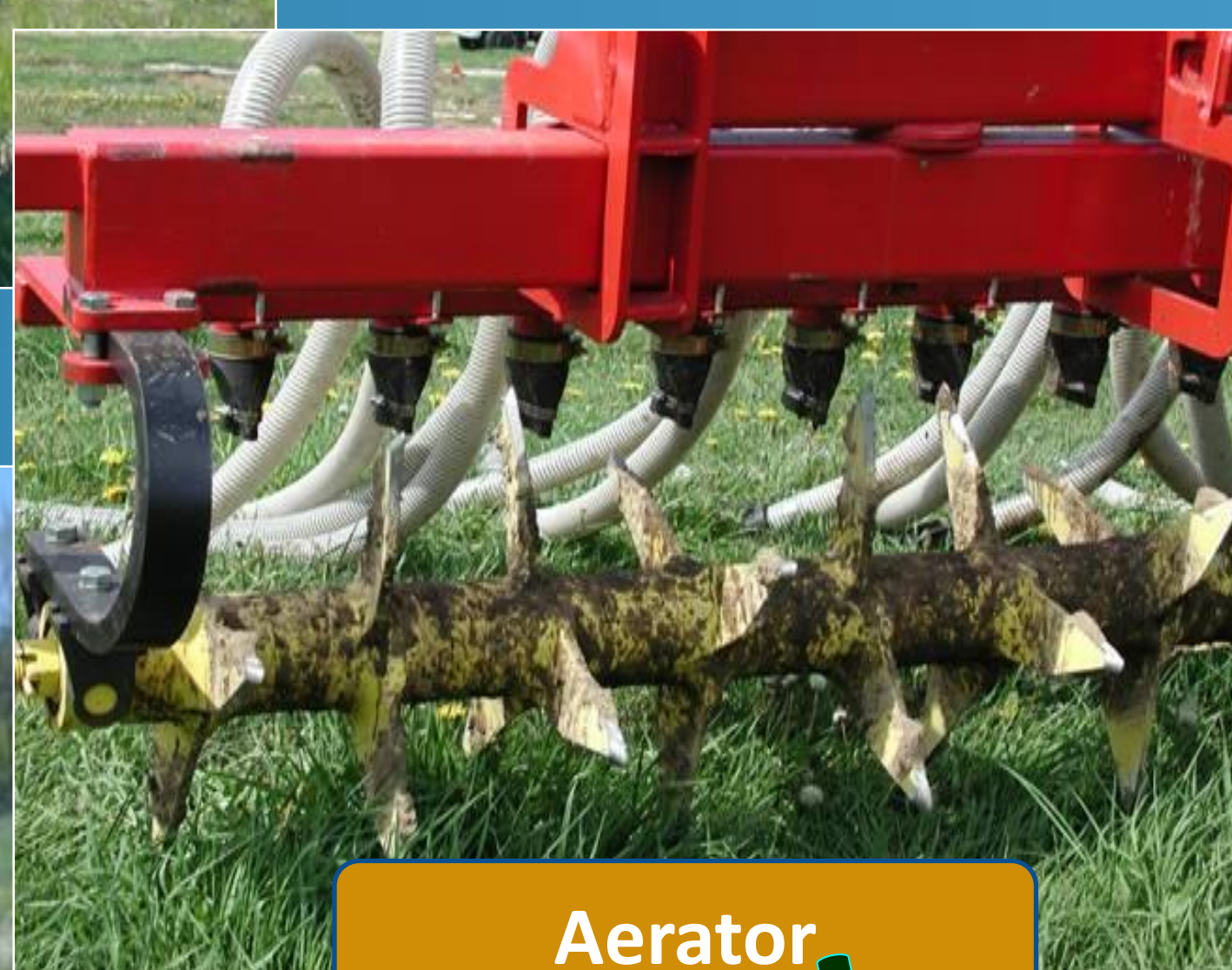


Soil profile of mean phosphorus concentration (ug P cm<sup>-2</sup>) at various depths (0-30 cm) determined by extraction with bicarbonate-saturated exchange resin membranes 7, 30, and 180 days after dairy manure application.

## Manure Technologies



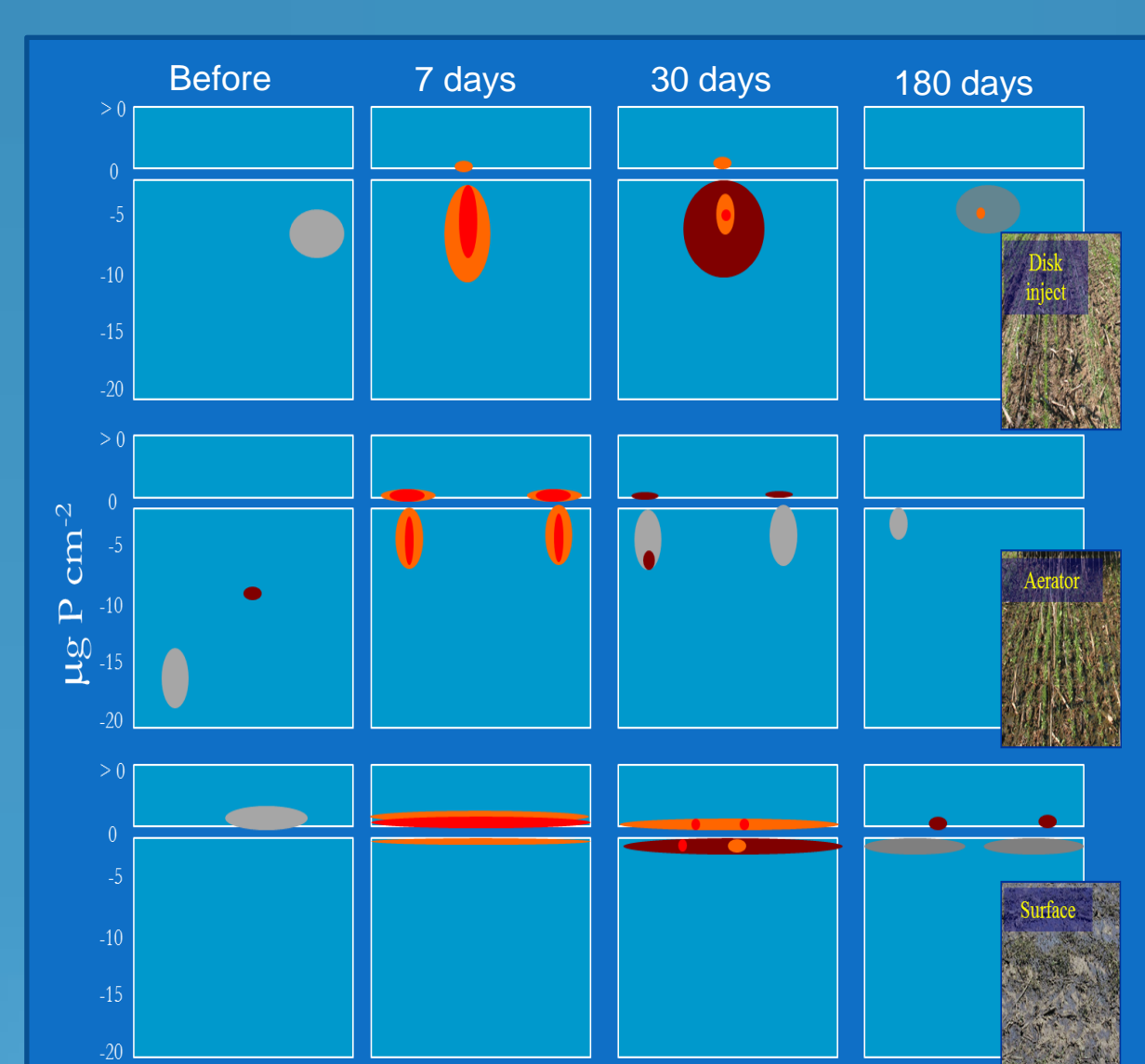
Broadcast



Aerator

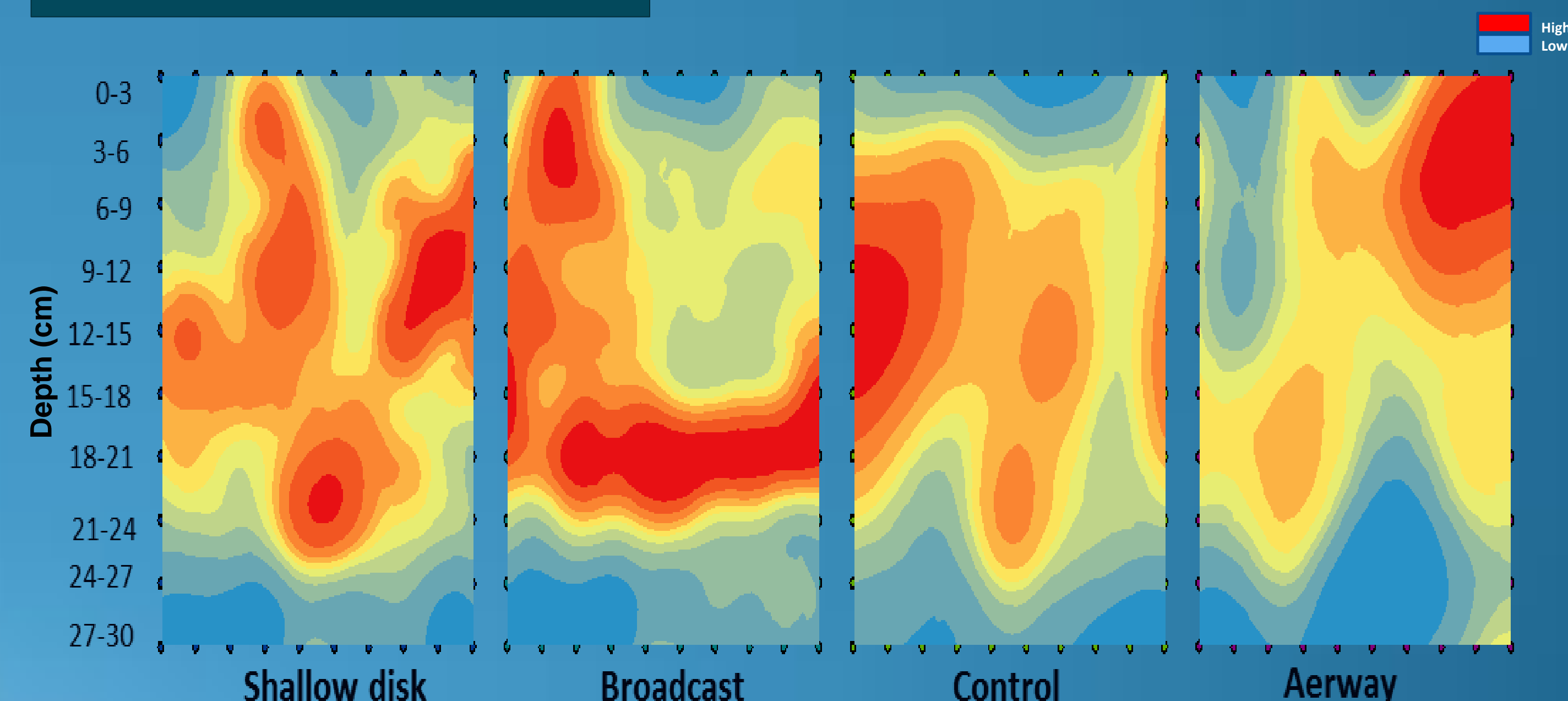


Shallow Disk



Expected vertical and horizontal phosphorus movement in soil

## Limitations



Profile of phosphorus concentration (ug P cm<sup>-2</sup>) determined by extraction with bicarbonate-saturated exchange resin membranes 7 days after manure application. Phosphorus concentrations range (0.01-0.15 ug P cm<sup>-2</sup>). Map was created using Arc GIS.

- Results were inconclusive with regard to the spatial distribution of extractable phosphate
- Coefficient of variation for treatment, time, and treatment X time effects, showed no significant differences
- Little evidence of expected spatial signatures between the various methods.
- Soil moisture is likely an important factor affecting phosphate recovery with this technique
- Preliminary observations suggest that this method may be better suited to mapping nitrate distribution in soils.

## Future Research

More research is needed to find a standardized method for using ion exchange membrane to measure nutrients in soil

## Key References

- Johnson, K.N., P.J.A. Kleinman, D.B. Beegle, H.Elliott, and L. Saporito. 2011. Effect of dairy manure slurry application in a no-till system on phosphorus loss in surface runoff. *Nutrient Cycling in Agroecosystems* 90:201-212
- Kovar, J.L., T.B. Moorman, J.W. Singer, C.A. Cambardella, and M.D. Tomer. 2011. Swine manure injection with low-disturbance applicator and cover crops reduce phosphorus losses in runoff. *J. Environ. Qual.* 40:329-336

## Acknowledgements

USDA-ARS Pasture Systems and Watershed Management Laboratory and The Pennsylvania State Crop and Soil Science Department