Phosphorus Dynamics in Soils Receiving Chemically Treated Dairy Manure

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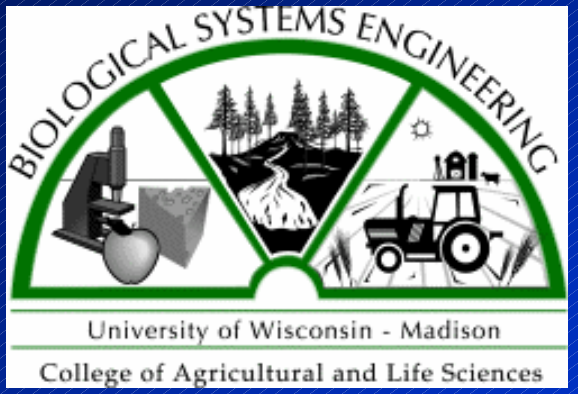


BACKGROUND

? Agricultural inputs of N and P are major contributors to non-point source pollution.

? Current focus is on “P” and greater concern in regions around concentrated livestock operations.

? Impending P-based regulations will require development and use of practices that will minimize P loading in “*hot-spots*.”

BACKGROUND

? Concentration of solids and P in a smaller volume will increase management options.

? Physical separation using gravity-based sedimentation/ mechanical separators are economical. However, longer settling periods are required and ineffective for DRP.

? Chemical treatment using well-known coagulants increasingly being considered for animal manure treatment.

CHEMICAL TREATMENT

- Salts of Fe, Al, and Ca are capable of efficiently concentrating manure solids and nutrients

- CREATES MORE MANURE MANAGEMENT OPTIONS

KNOWLEDGE GAP

OBJECTIVES

The overall goal is to investigate the interaction of P in chemically treated manure with soil.

Specific objectives are to study:

1) The effect of chemical treatment type on short- and long- term P dynamics in soils.

2) The effect of incubation time, application rate, and background soil P level on amount of P released.

EXPERIMENTAL

- 3 surface soils [varying Bray-I P content]
- 4 manure treatments [untreated; 3 chemical treatments]
- 1 fertilizer treatment [MCP]
- Control (no P input)

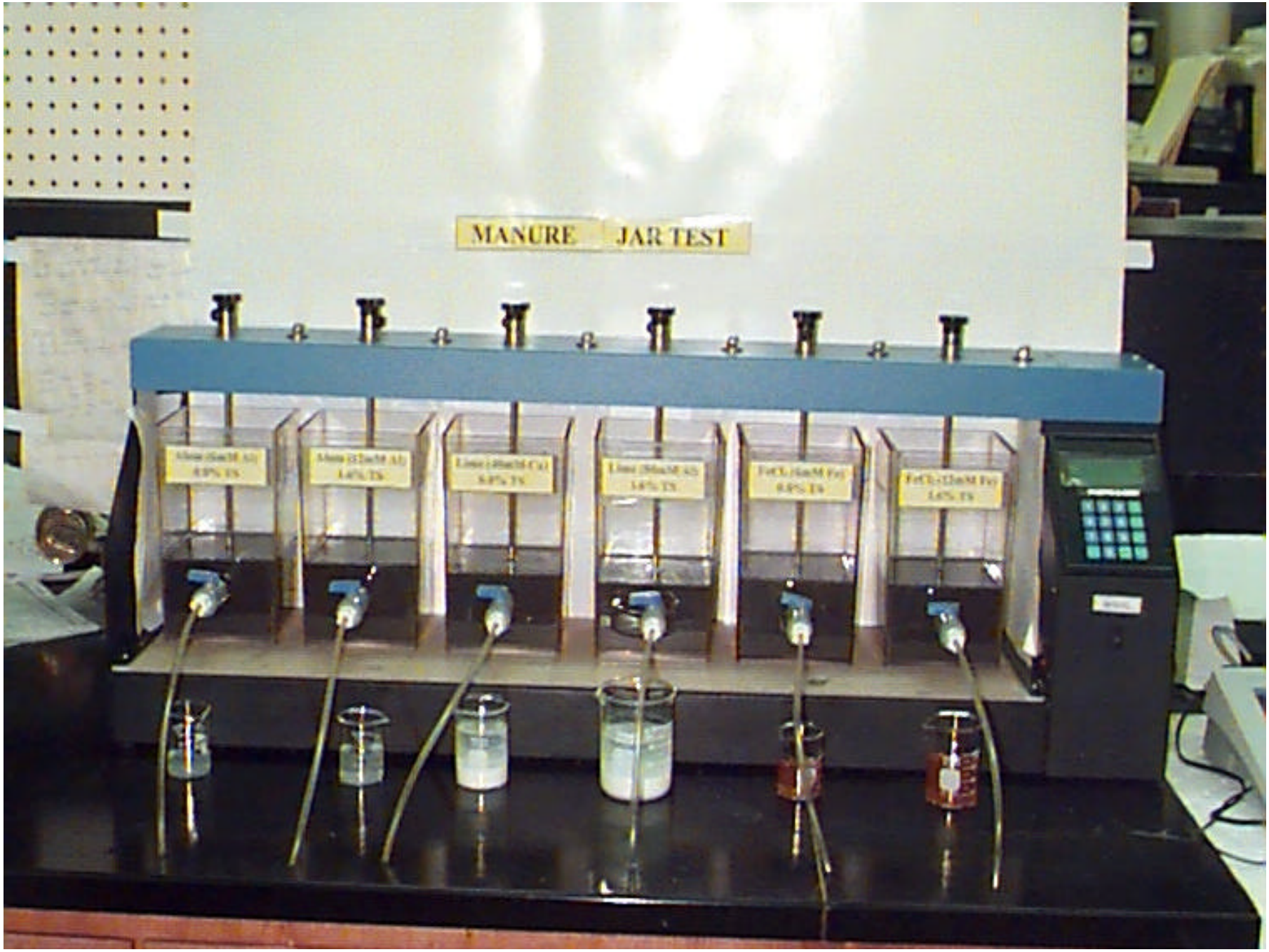
33 treatments

- 2 application rates: 25 and 50 kg P/ha
- 8 incubation periods: 1 d; 1 and 2 w; 1, 3 and 6 m; 1 and 2 yr
- Constant moisture and temperature (25 ^{o}C)

SELECTED PROPERTIES OF SOILS

Soil Id.	*pH*	*DRP (mg P/kg)*	*Bray-1 P (mg P/kg)*	*TP (mg P/kg)*	*Texture*	*OC (%)*
I	7.11	0.68	12.0 LOW	422.5	SiL	2.41
II	7.00	5.67	66.0 HIGH	549.5	SiL	2.42
III	7.02	8.69	94.0 VERY HIGH	697.2	SiL	2.60

SiL= Silt Loam


MANURE JAR TEST

MANURE AND CHEMICALLY TREATED MANURE

Sample ID	*pH*	*TP (mg/kg)*	*Ca/P*	*Mg/P*	*Al/P*	*Fe/P*
UM	8.49	300	2.73	2.85	0.07	0.05
ATM	6.92	197	2.04	1.68	4.01	0.05
ITM	7.97	217	1.97	1.68	0.08	3.55
LTM	7.79	561	10.11	2.49	0.09	0.07

UM=Untreated manure; ATM=Alum treated manure,
ITM= Iron treated manure; LTM= Lime treated manure

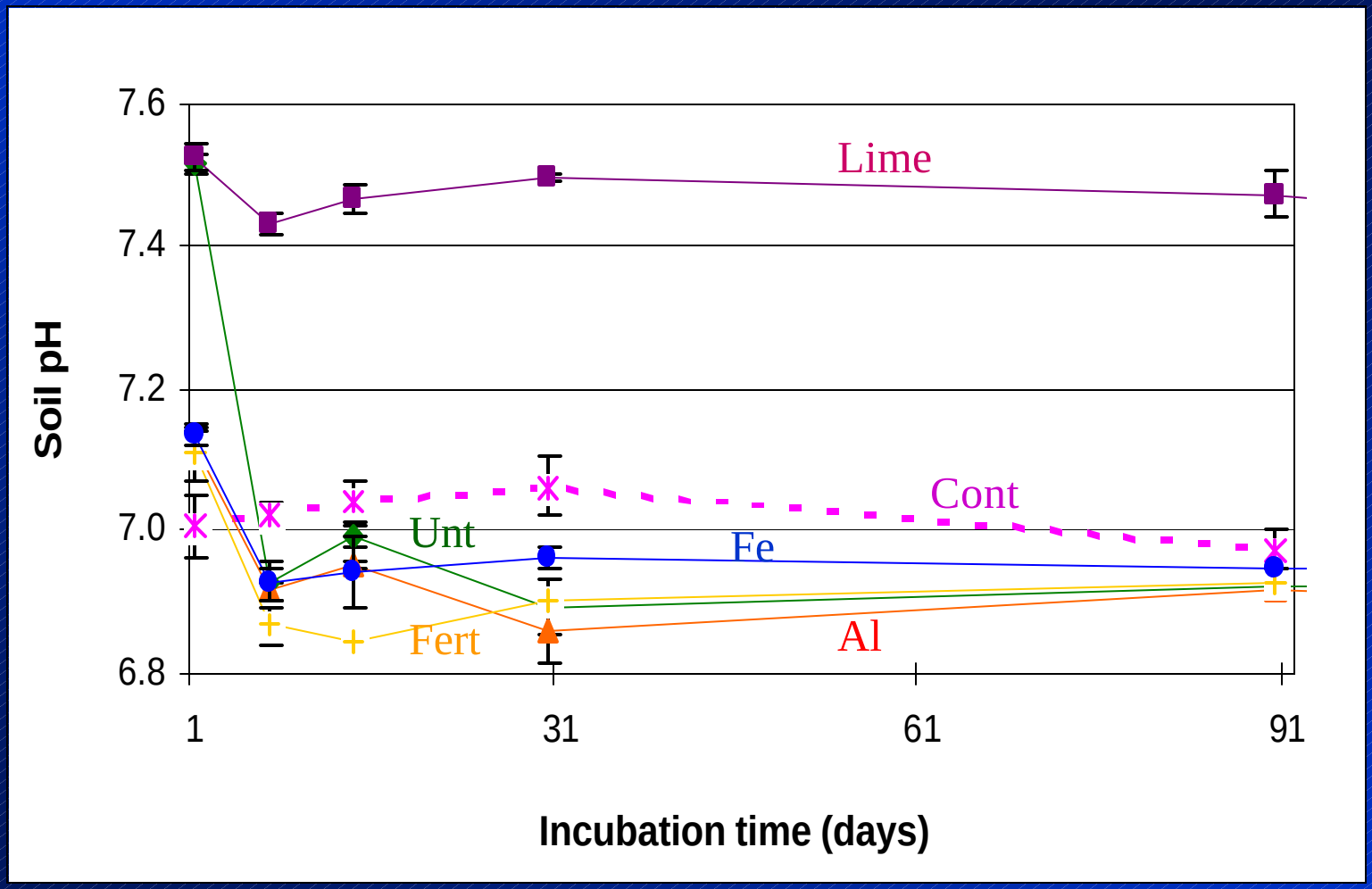
INCUBATION EXPERIMENT

- 75 g soil was mixed with manure, treated manure, or fertilizer.
- DI-H_2O was added to reach 50% water holding capacity.
- Treated samples were transferred into 125 ml jars with perforated lids and incubated.
- Moisture content adjusted periodically.
- Soils were air-dried, crushed and passed through 2 mm sieve.

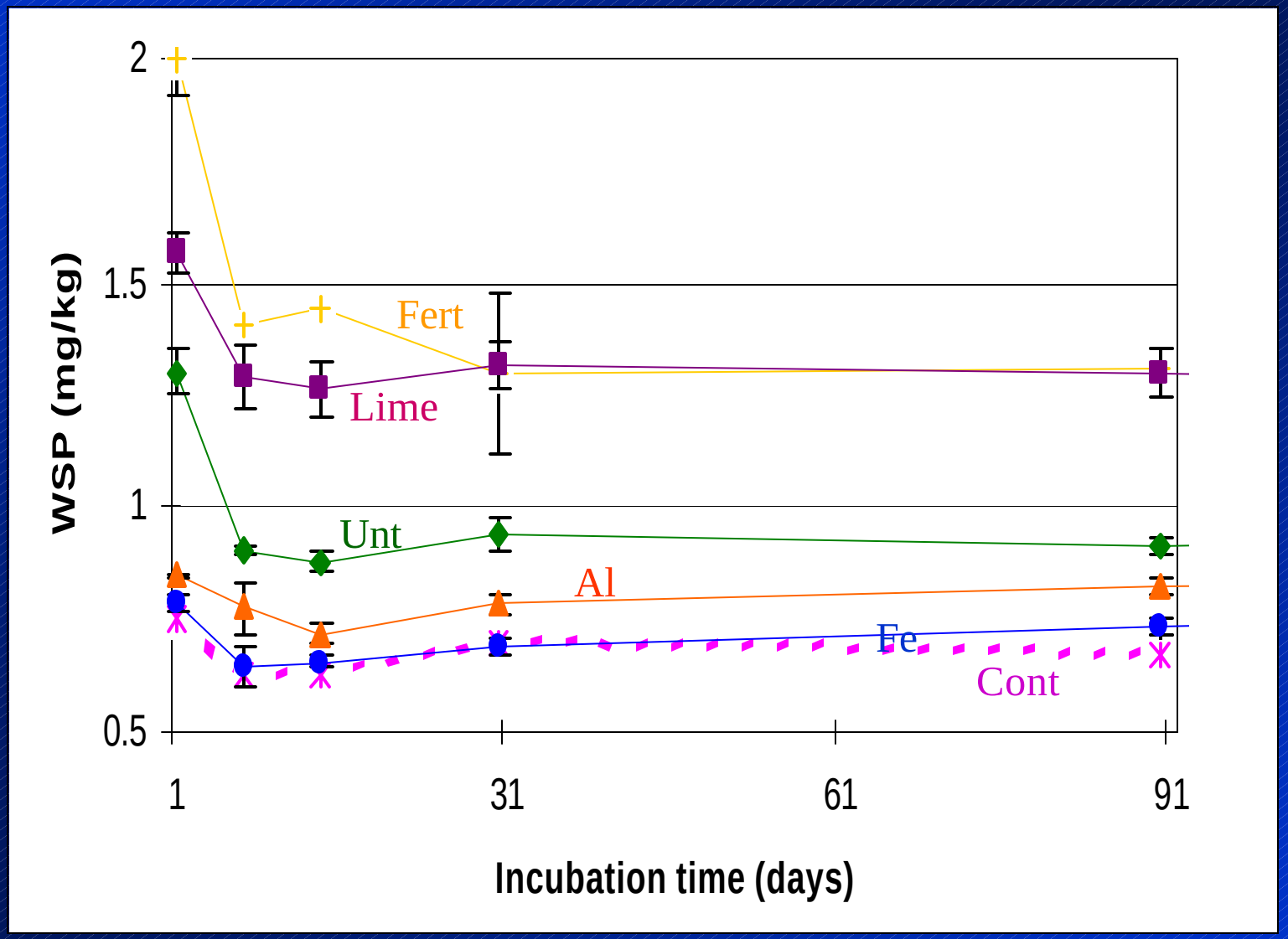
MEASUREMENTS

- pH, EC
- Water-soluble P, Bray-1 P
- Sequential P extraction:
  - NH_4Cl (soluble and loosely bound)
  - NH_4F (Al-bound)
  - NaOH (Fe-bound)
  - HCl (Ca-bound)
  - Ashing and solubilizing with HCl (Residual)

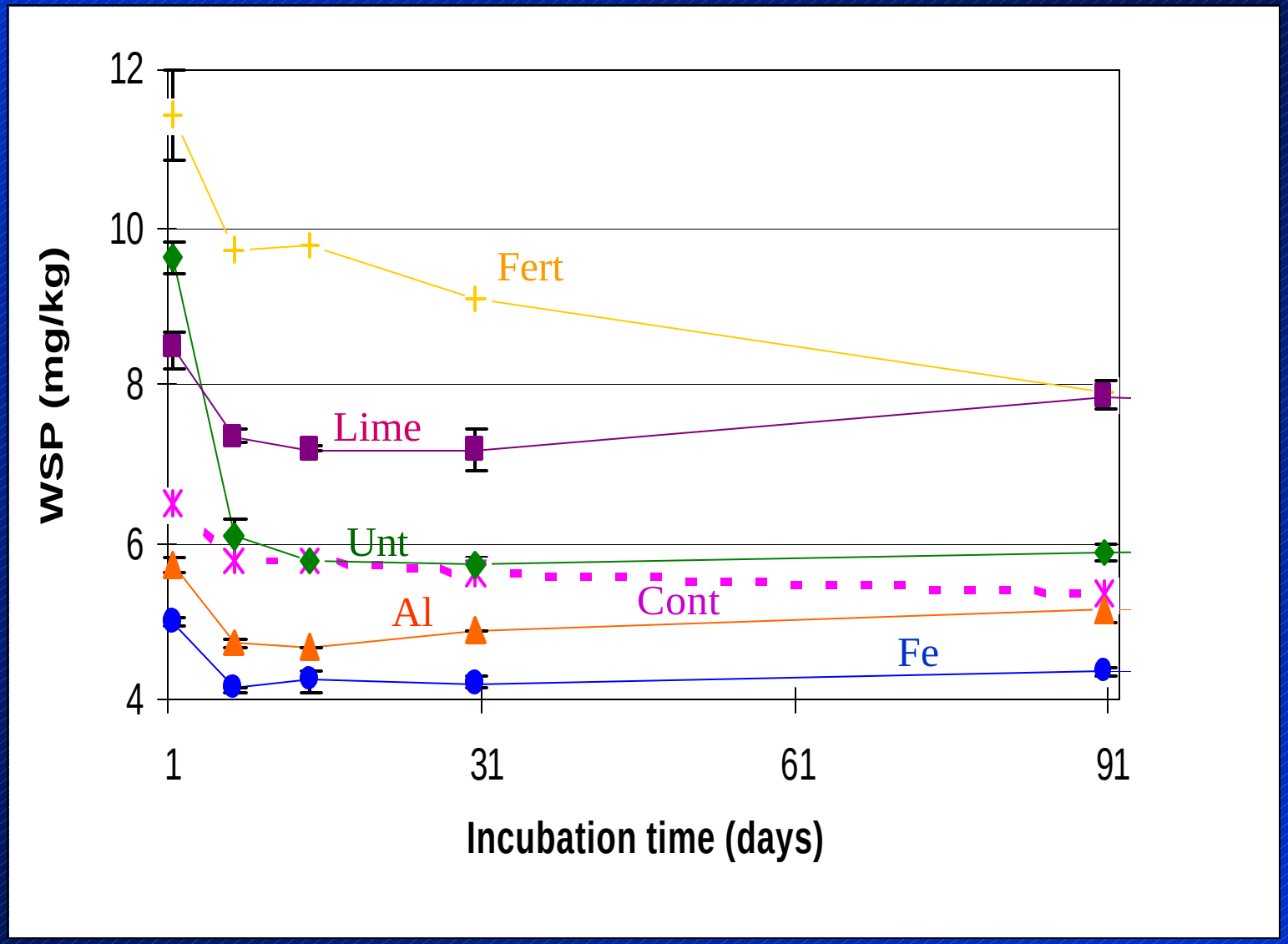
Soil pH – Soil II



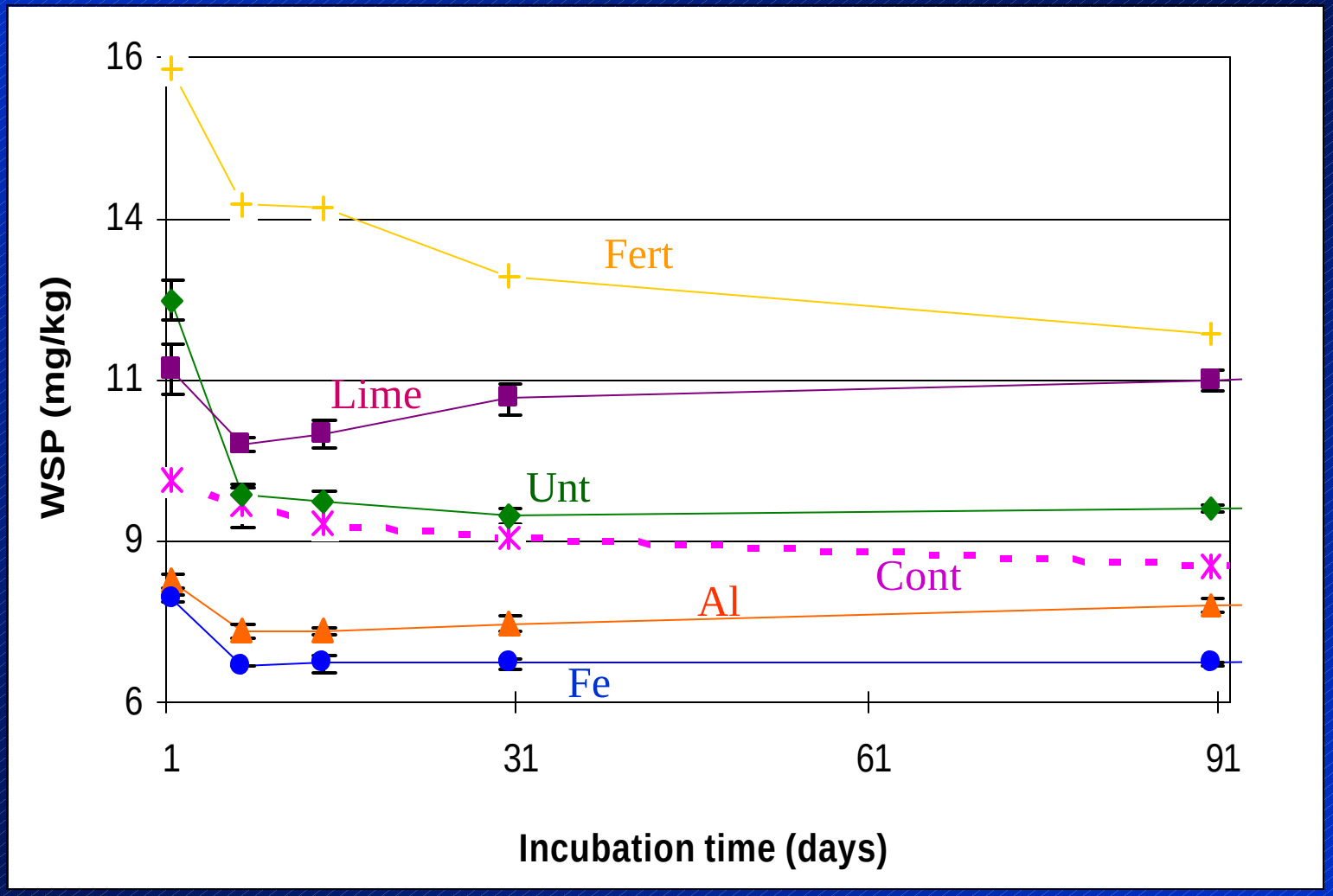
Water-soluble P – Soil I



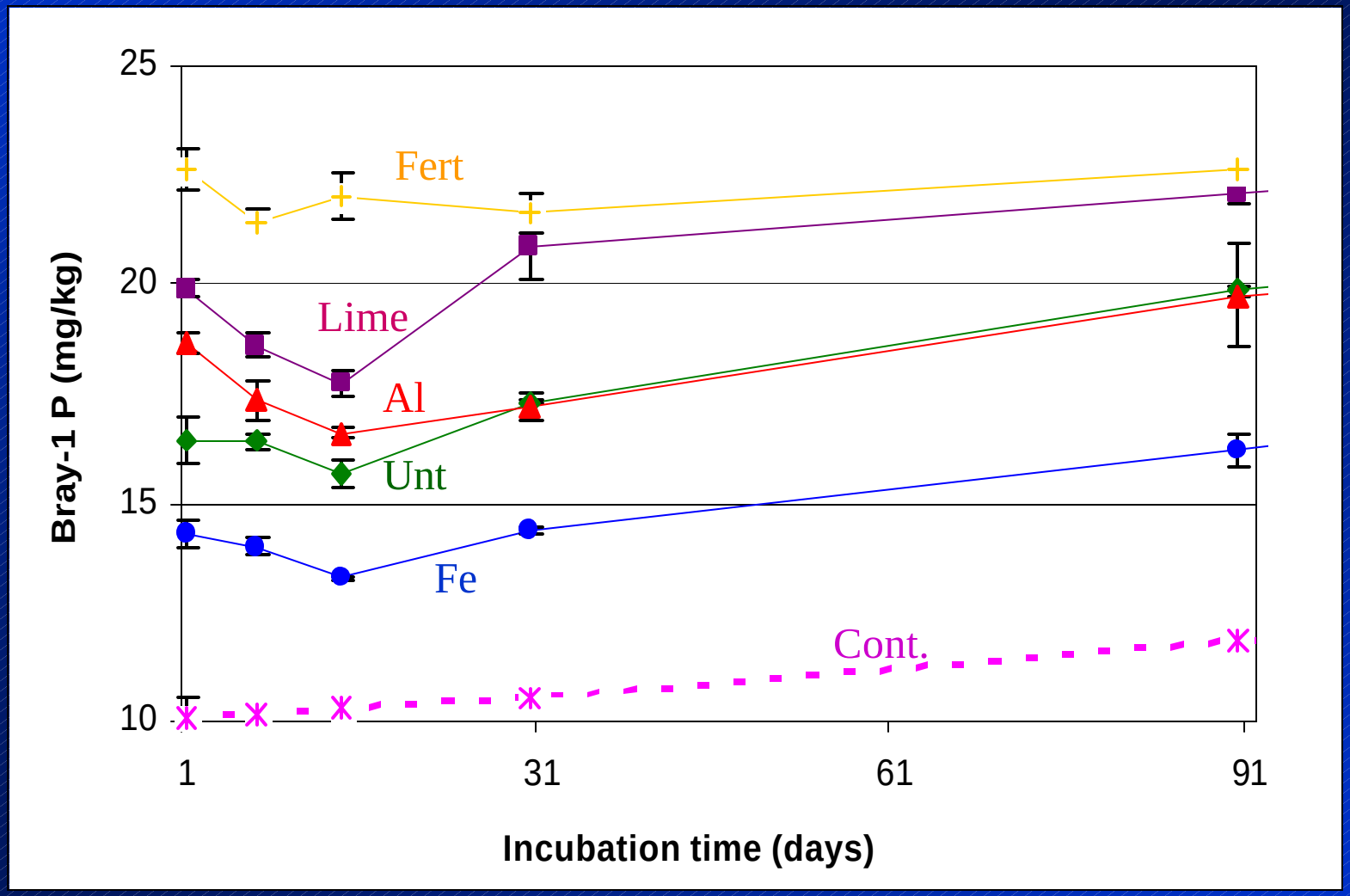
Water-soluble P – Soil II



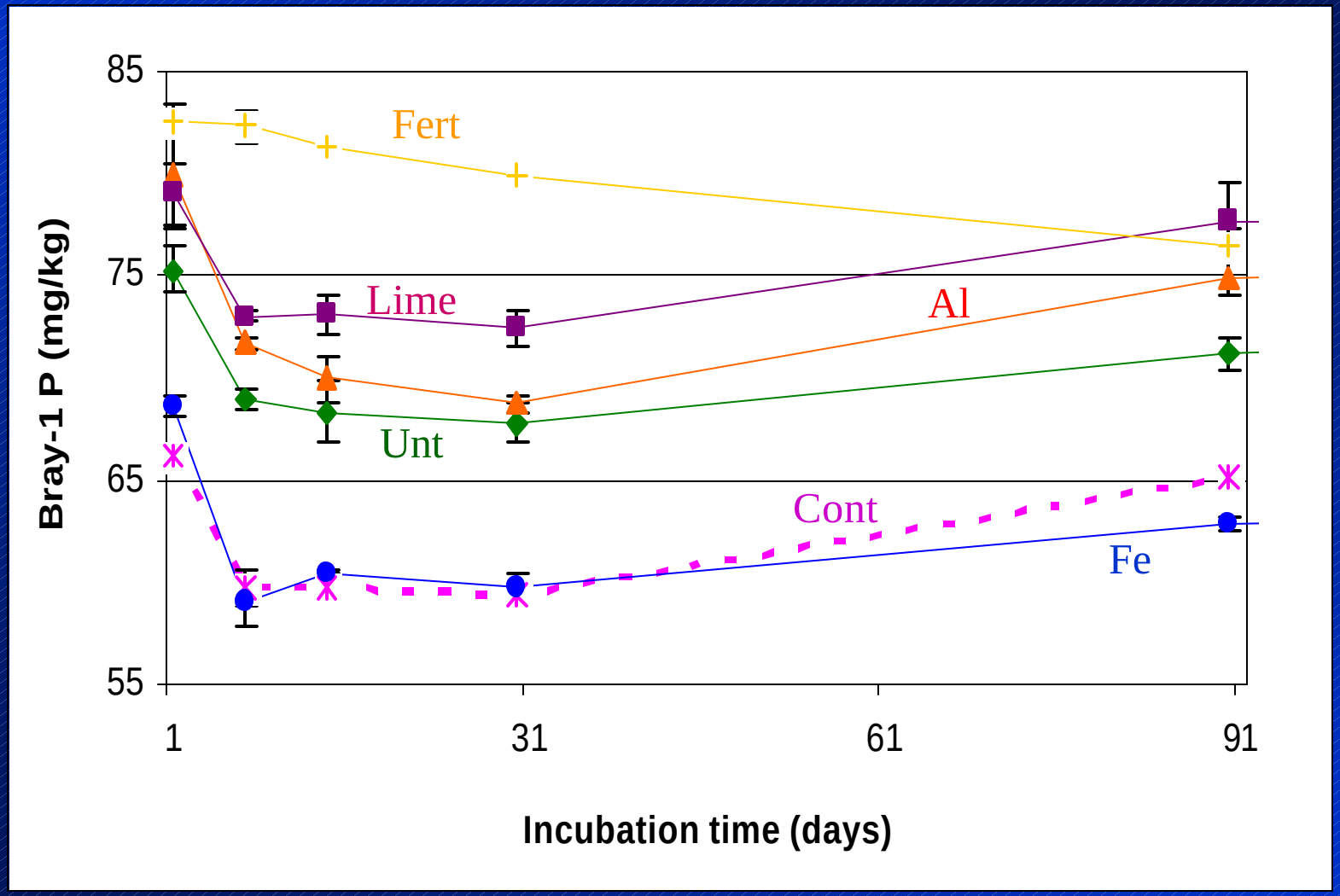
Water-soluble P – Soil III



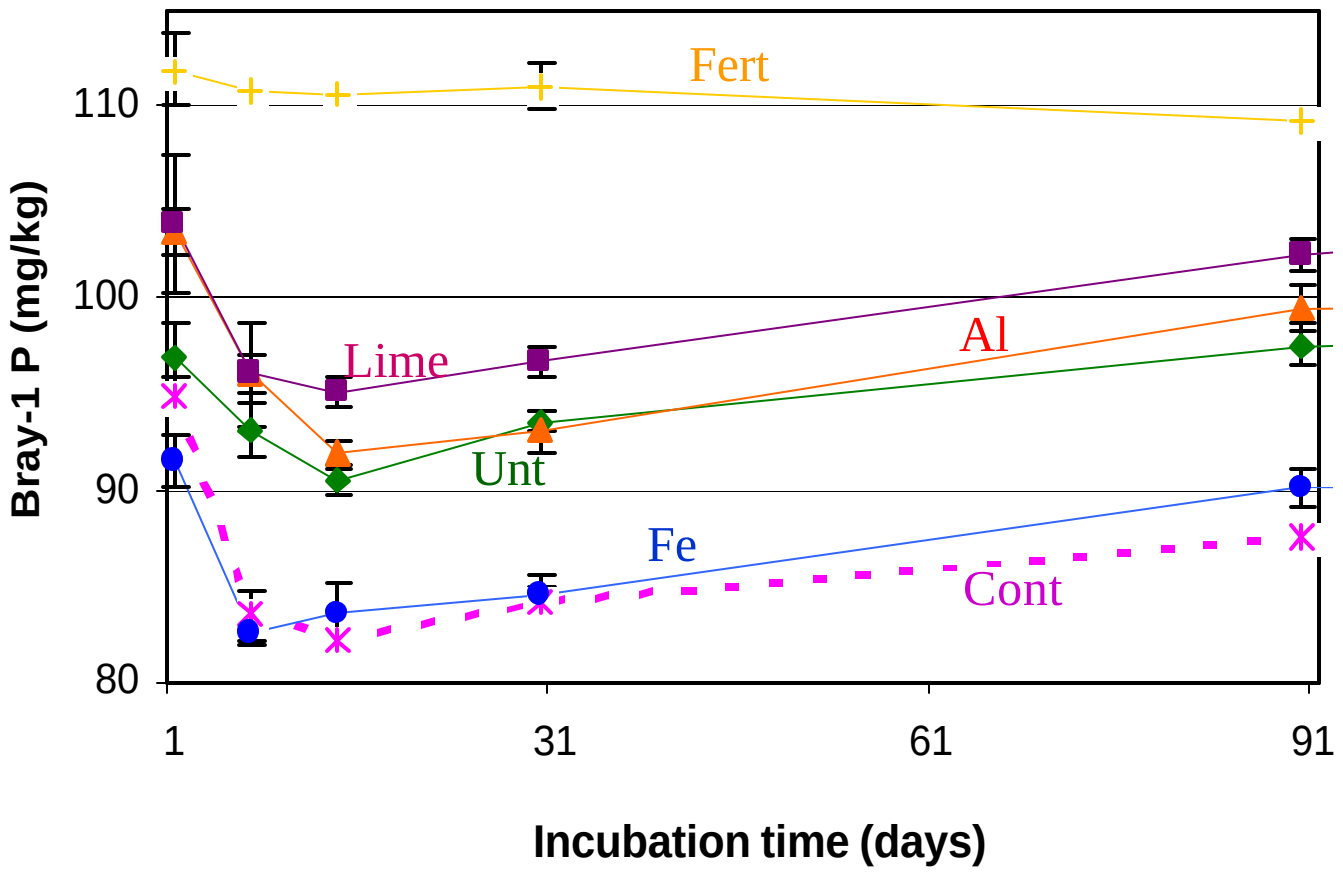
Bray-1 P – Soil I



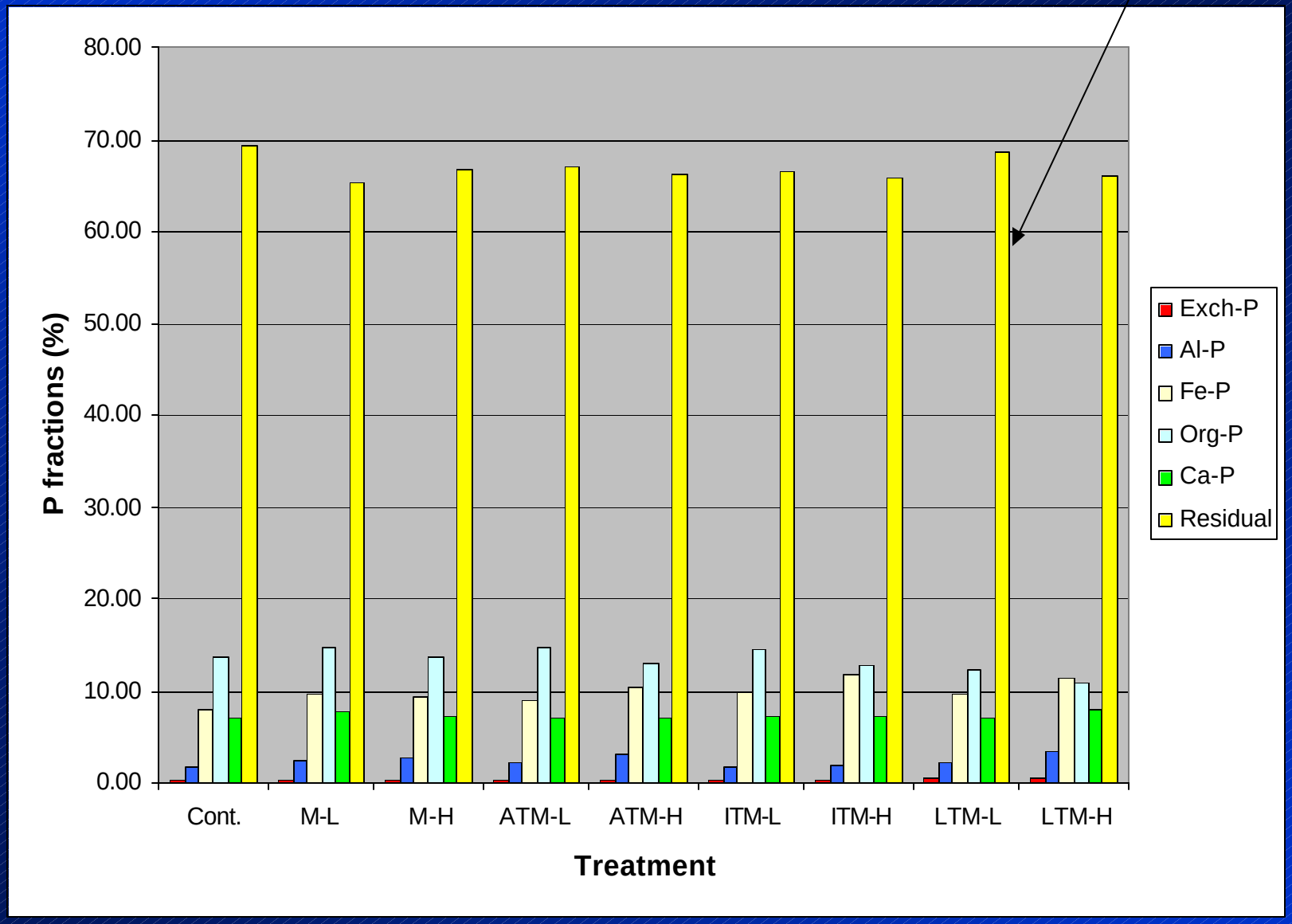
Bray-1 P – Soil II



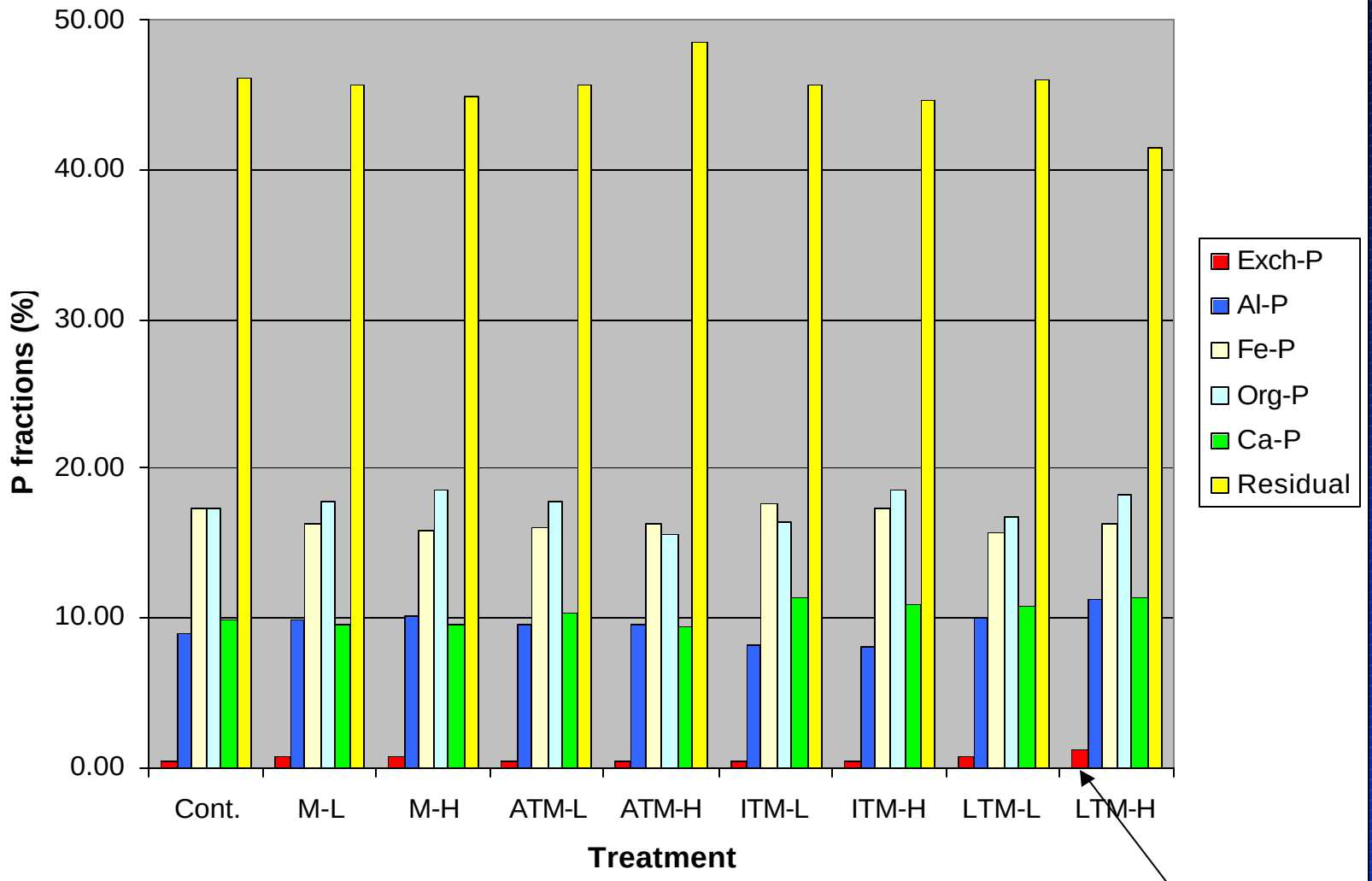
Bray-1 P – Soil III



P Fractionation – Soil I



P Fractionation – Soil II



Soluble

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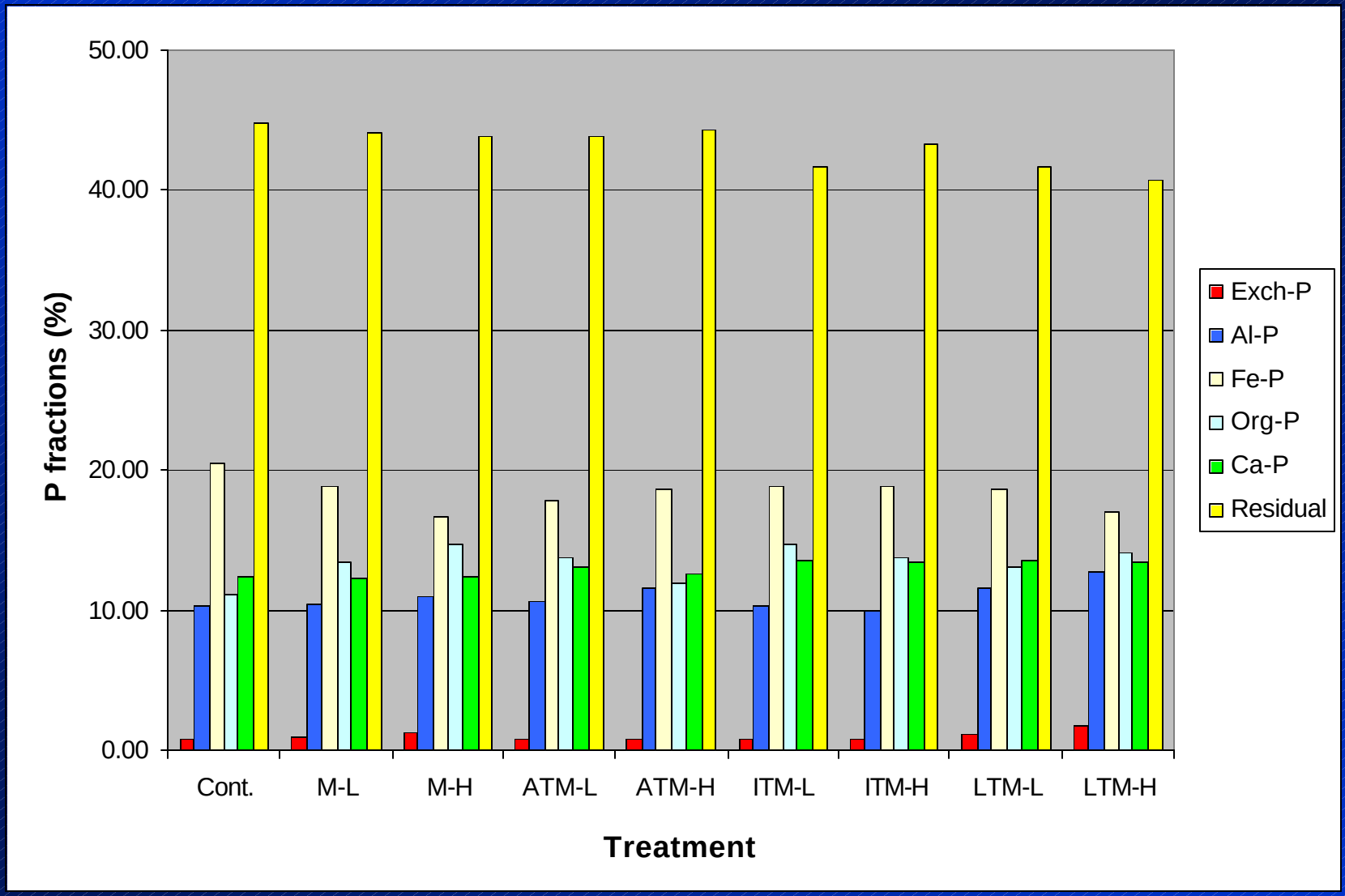

SUMMARY & CONCLUSIONS

? Water-soluble P increased when soils were mixed with MCP, manure or Ca-treated manure. Increase was proportional to application rate.

? Water-soluble P decreased when soils with high background P received Al or Fe -treated manure. For soil with low background P, water-soluble P increased slightly.

? Bray-1 P increased for all treatments and soils in the order: MCP > Ca-treated > Al-treated ≥ Untreated > Fe-treated.

SUMMARY & CONCLUSIONS

- Water-soluble and Bray-1 P decreased sharply between 1 d and 1 or 2 w and then either slightly increased or remained constant.
- Soil pH increased significantly for soils receiving Ca-treated manure. It decreased slightly or remained relatively constant for other treatments.
- Treatment of dairy manure with alum or $FeCl_3$ decreases P solubilization from the soil, especially in soils with high background P.
- Treatment with lime increases both the solubility and bio-availability of P in soil.

ACKNOWLEDGMENTS

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