Soil Fertility Management with Dairy Compost in an Organic, High-Elevation Alfalfa System

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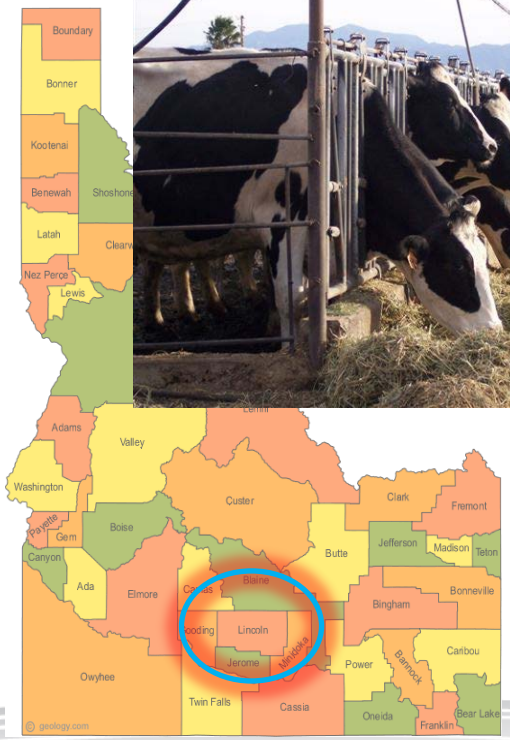
Outline

- Dairy Compost/Manure Review
- Dryland, high-elevation dairy compost research methods, results, and preliminary summary
- Importance of understanding nutrient value of dairy compost or manure

Dairy Manure: An abundant resource in Idaho

- 3rd Dairy State in the Nation
- Standing herd of 576,000 cows estimated in 2011
- Idaho dairies produce an estimated 6.2 million tons of raw dairy manure each year



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Mir-M., S. (2010). Understanding the Composting Process. In press.

Compost & Manure Can:

- ✓ Provide soil nutrients
- ✓ Improve soil properties and overall soil quality/structure
- ✓ Improve water-holding capacity
- ✓ Increase soil organic matter (OM)

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Wilkinson, S.R. 1979. Plant Nutrient and Economic Value of Animal Manures. Publication from USDA-ARS/UNL Faculty. Paper 268.
Araji, A.A. & Abdo, Z.O. Optimal Utilization of Animal Manure on Cropland.

Increasing OM: Compost & Manure

- ✓ Manure/Compost provide food for soil microbes; healthy populations of soil microbes create a balanced soil system that cycles nutrients more efficiently.

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Rosen, C.J. & Allen, D.L. (2007). Exploring the Benefits of Organic Nutrient Sources for Crop Production and Soil Quality. HorTechnology, Oct-Dec, 17 (4).

Organic Matter

- Soil OM promotes a good cation exchange capacity (CEC).
- A good CEC enhances the soil holding capacity of macronutrients as well as other micronutrients through various soil chemistry complexes.
- OM is a reservoir of nutrients and acts as a slow-release fertilizer.

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Dairy Compost

Finding the right formula

- Dependent on compost composition, soil nutrient availability, the crop grown, and local environmental conditions

→ mineralization rates

Eghball, B. et al. (2002). Mineralization of manure nutrients. Journal of Soil and Water Conservation, 57 (6).

Dairy Compost:
Mineralization

- Microbial conversion of organic nutrients into an inorganic form that plants can use.

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Falen, C., Seyedbagheri, M., Stark, J., and Shewmaker, G. “Compost Utilization in Production Agriculture”

Dairy Compost:
Mineralization Rates

- Impacted by:
  - ✓ Microbes
  - ✓Soil temperature
  - ✓Soil moisture
  - ✓Compost properties

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Eghball, B., Wienhold, B.J., Gilley, J.E., & Eigenberg, R.A. (2002). Mineralization of manure nutrients. Journal of Soil and Water Conservation. 57(6): 470-473.

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Methods

Plot Locations:

Camas & Blaine (high-desert, organic systems)

Crops: alfalfa and malting barley

- 4-year trial, with 4 replicated plots
- Plot size = 50 x 350 ft
- Applying 0, 5, and 10 tons/acre every fall
- Data Collecting:
  - Soil Mineralization (N, P, K)
  - Soil Residual Data (N, P, K)

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Methods:
Soil Data

- Buried bag technique
  - Pulled bag every 30 days during growing season
  - Analyzed for N, P, and K
- Residual soil data collected every fall (N, P, and K)

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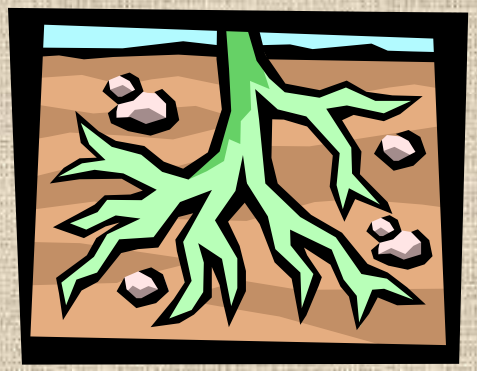
Results

Mineralization of N, P, K

Soil Residual of N, P, K

Economic Value



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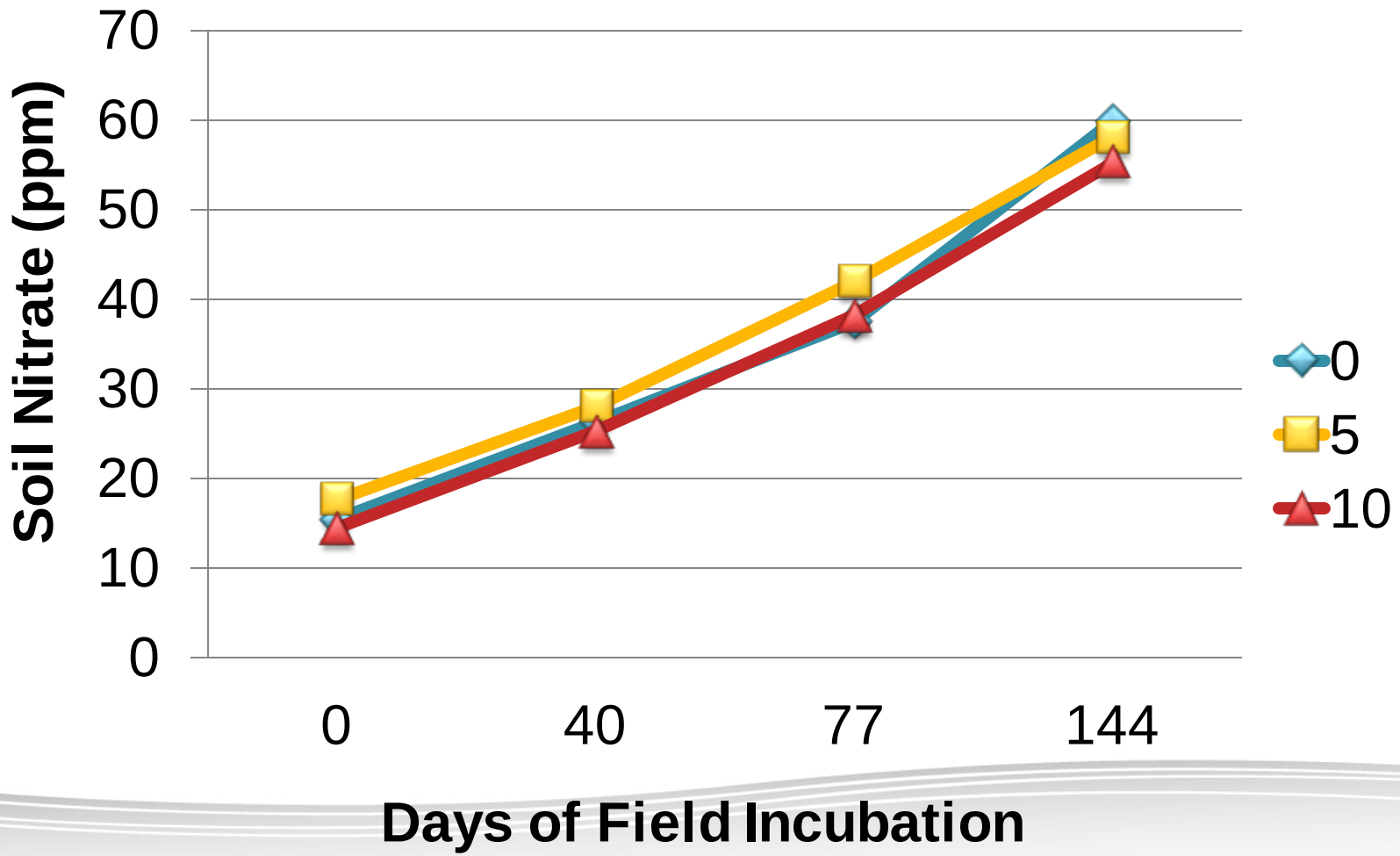
2010 Mineralization: Soil NO_3



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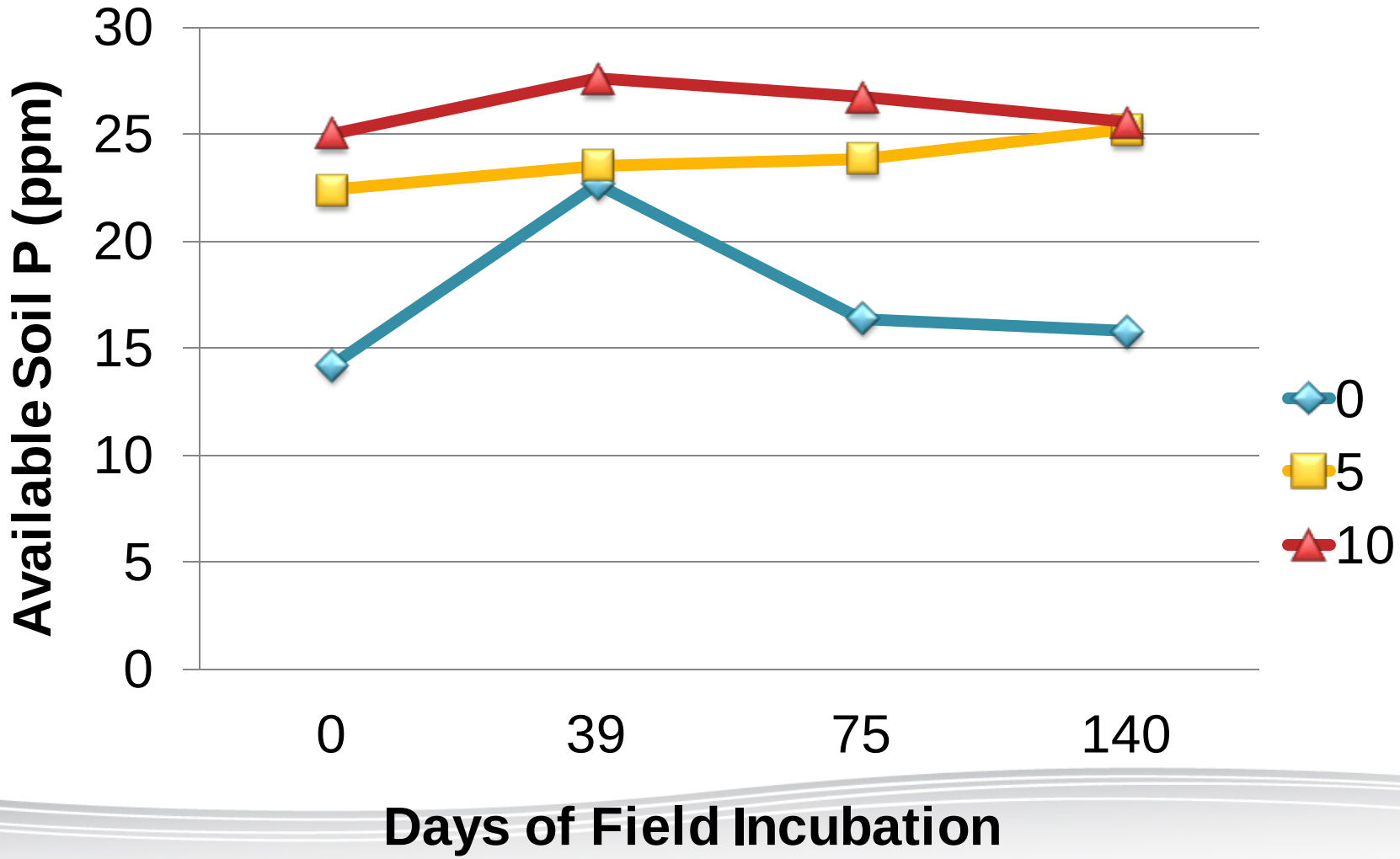
2010 Mineralization: Soil P



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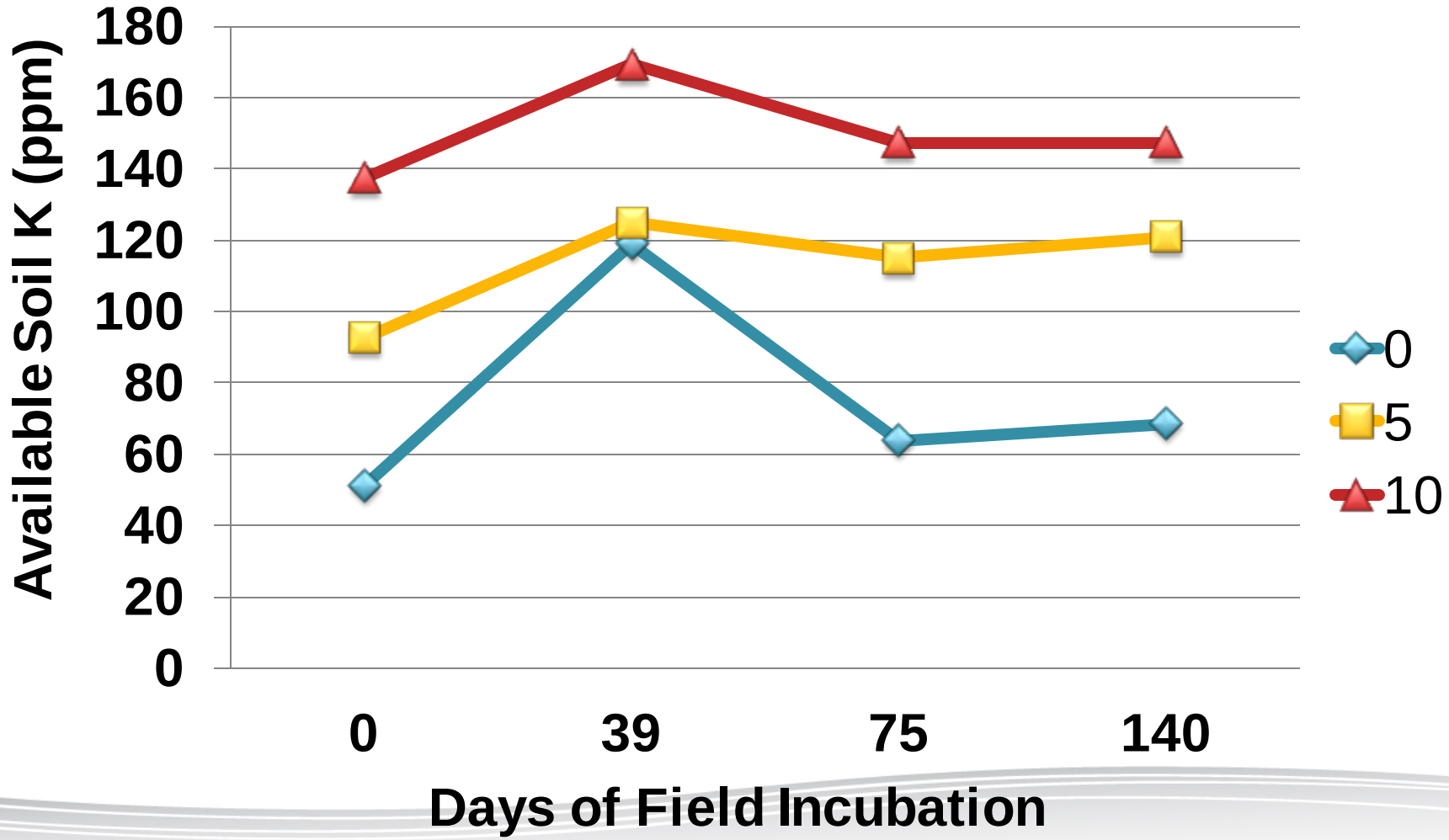
2010 Mineralization: Soil K



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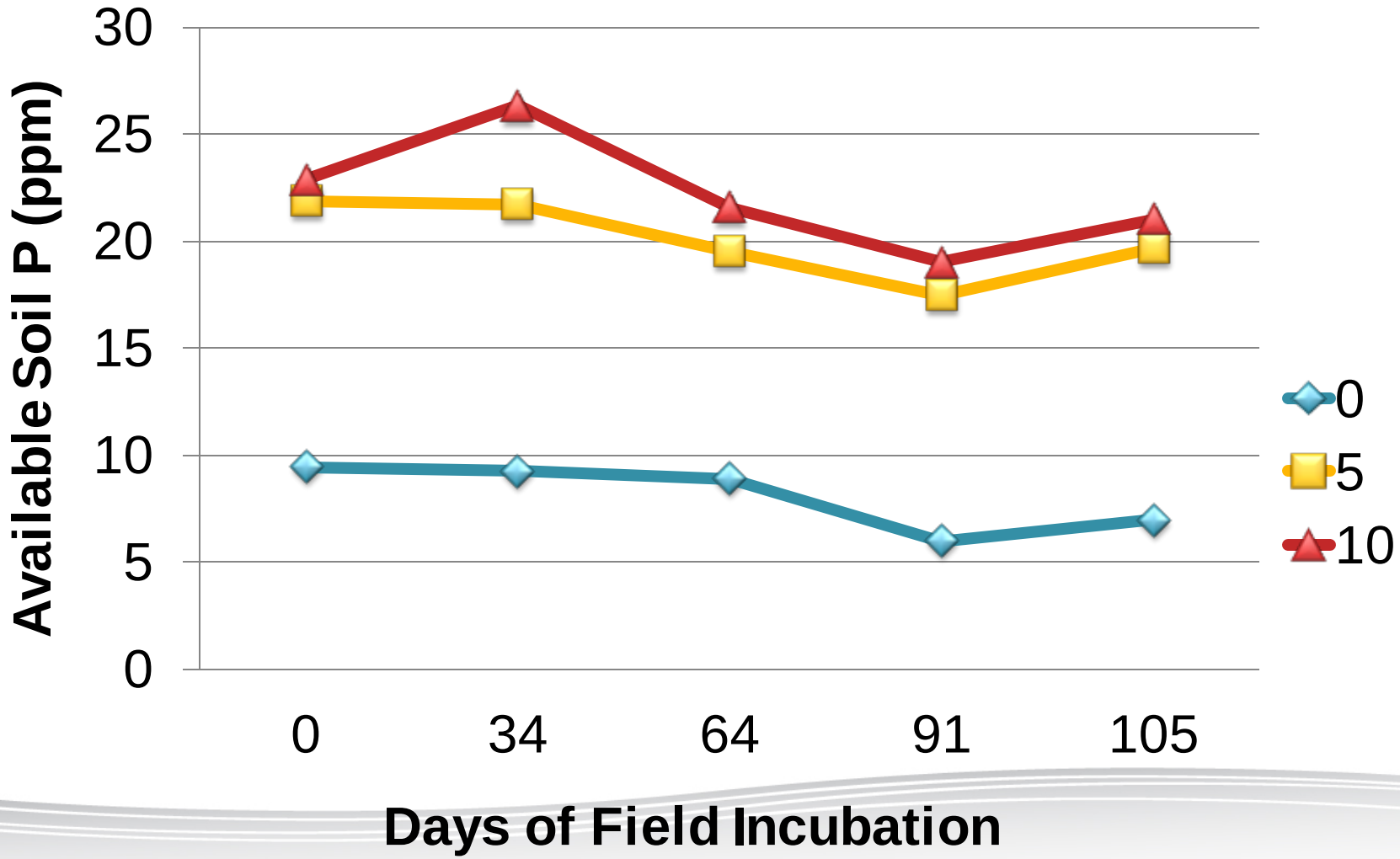
P = 0.05

2011 Mineralization: Soil P



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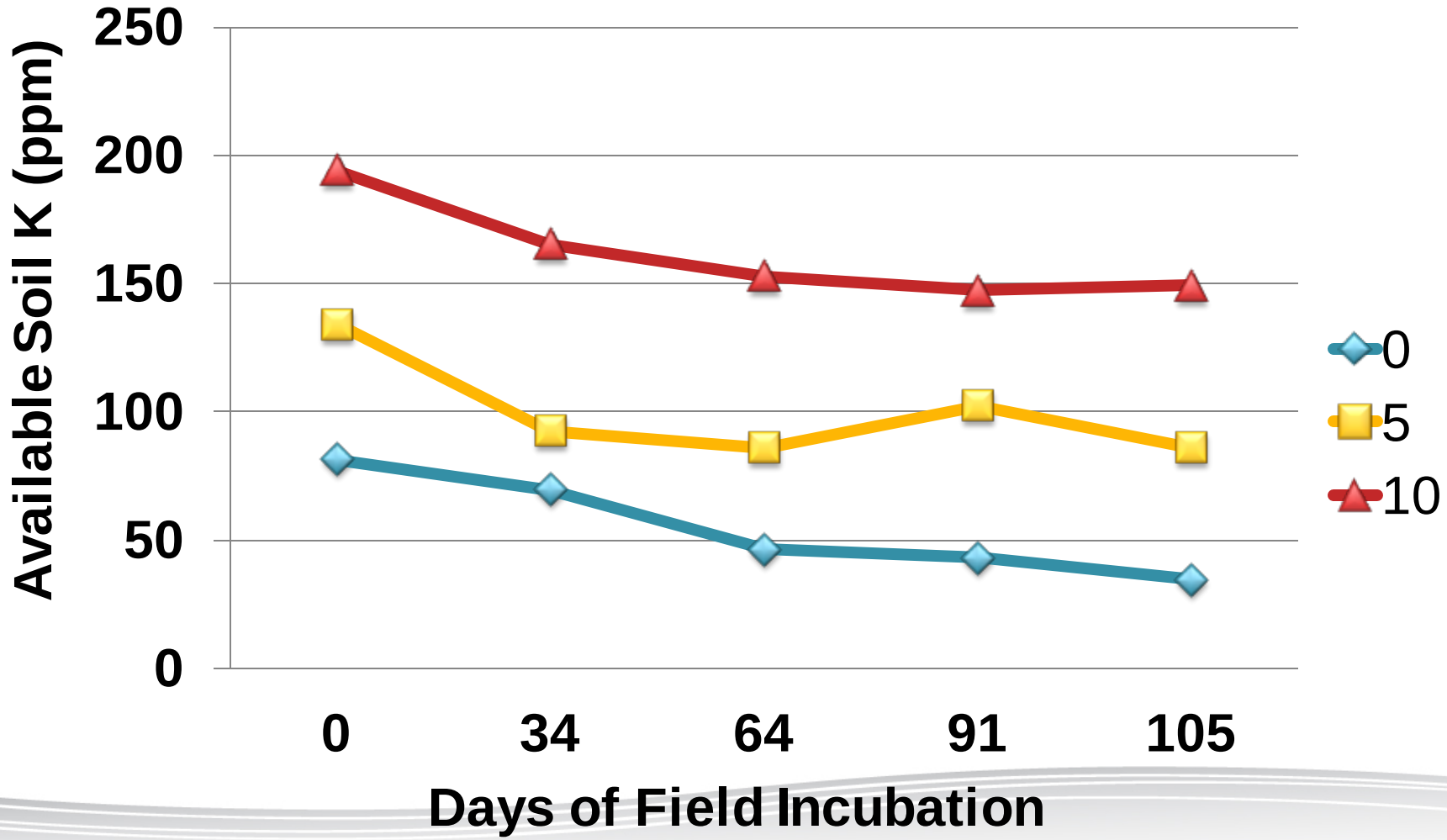
2011 Mineralization: Soil K



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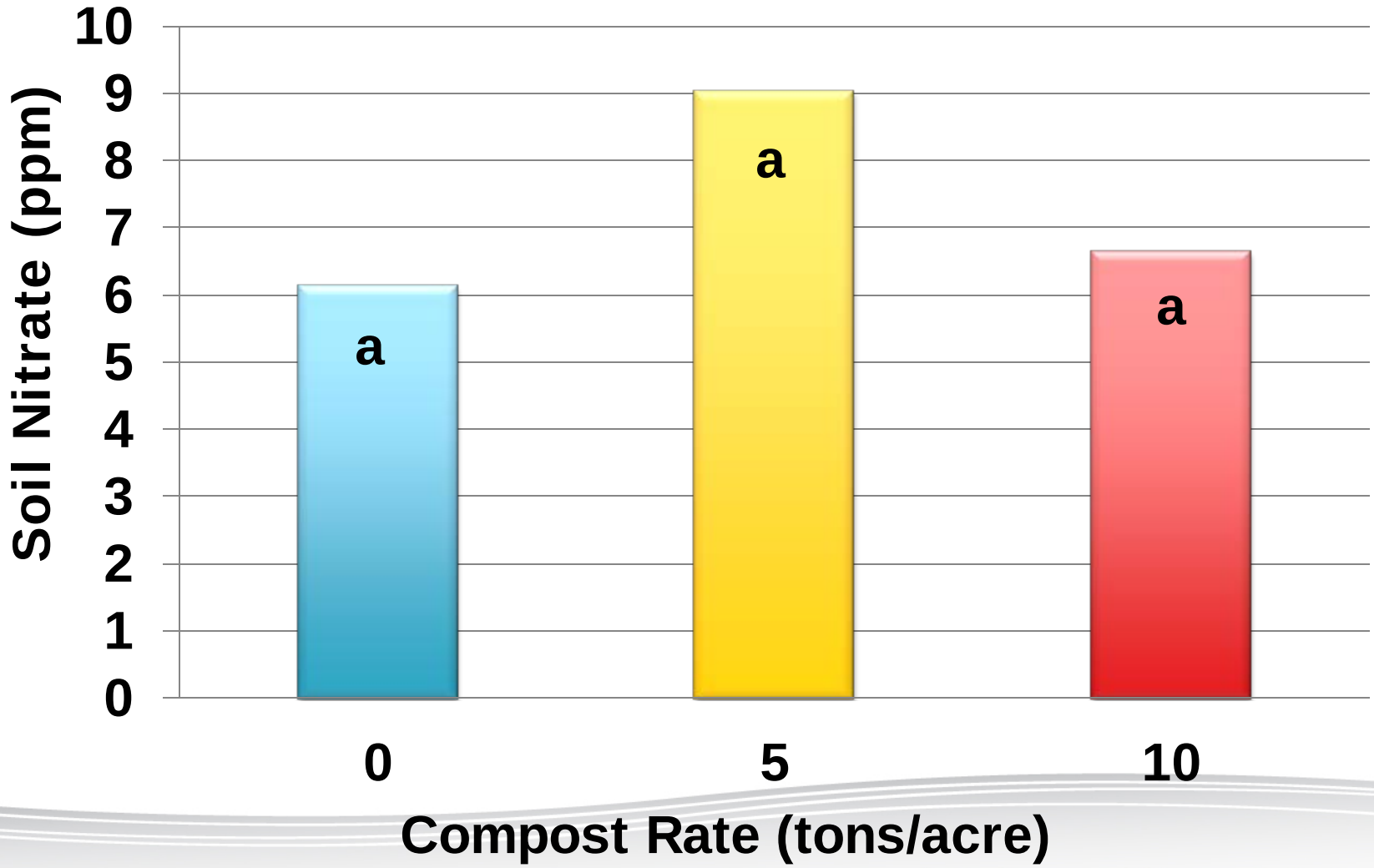
2010 Residual Soil N



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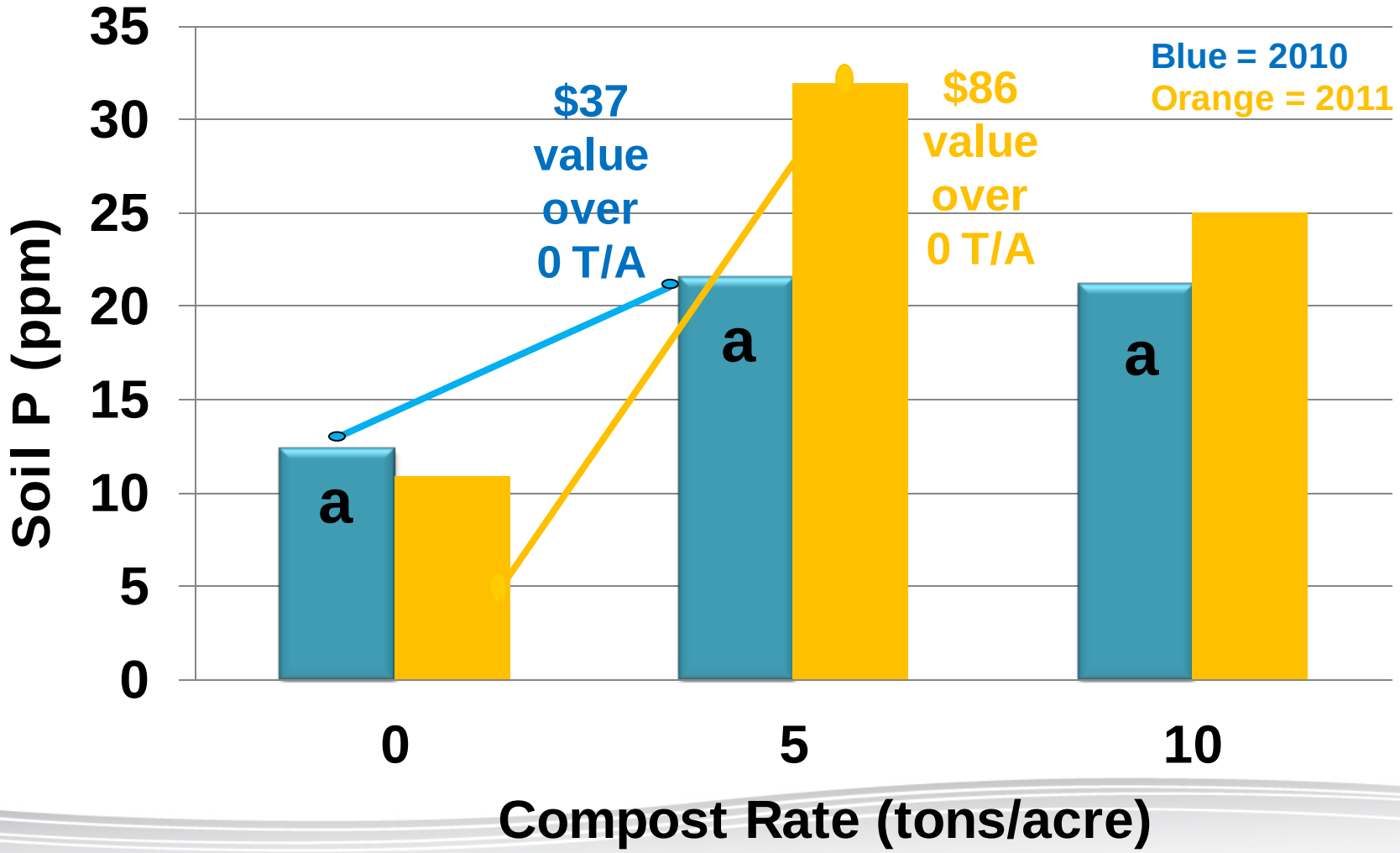
2010-11 Blaine Residual Soil P



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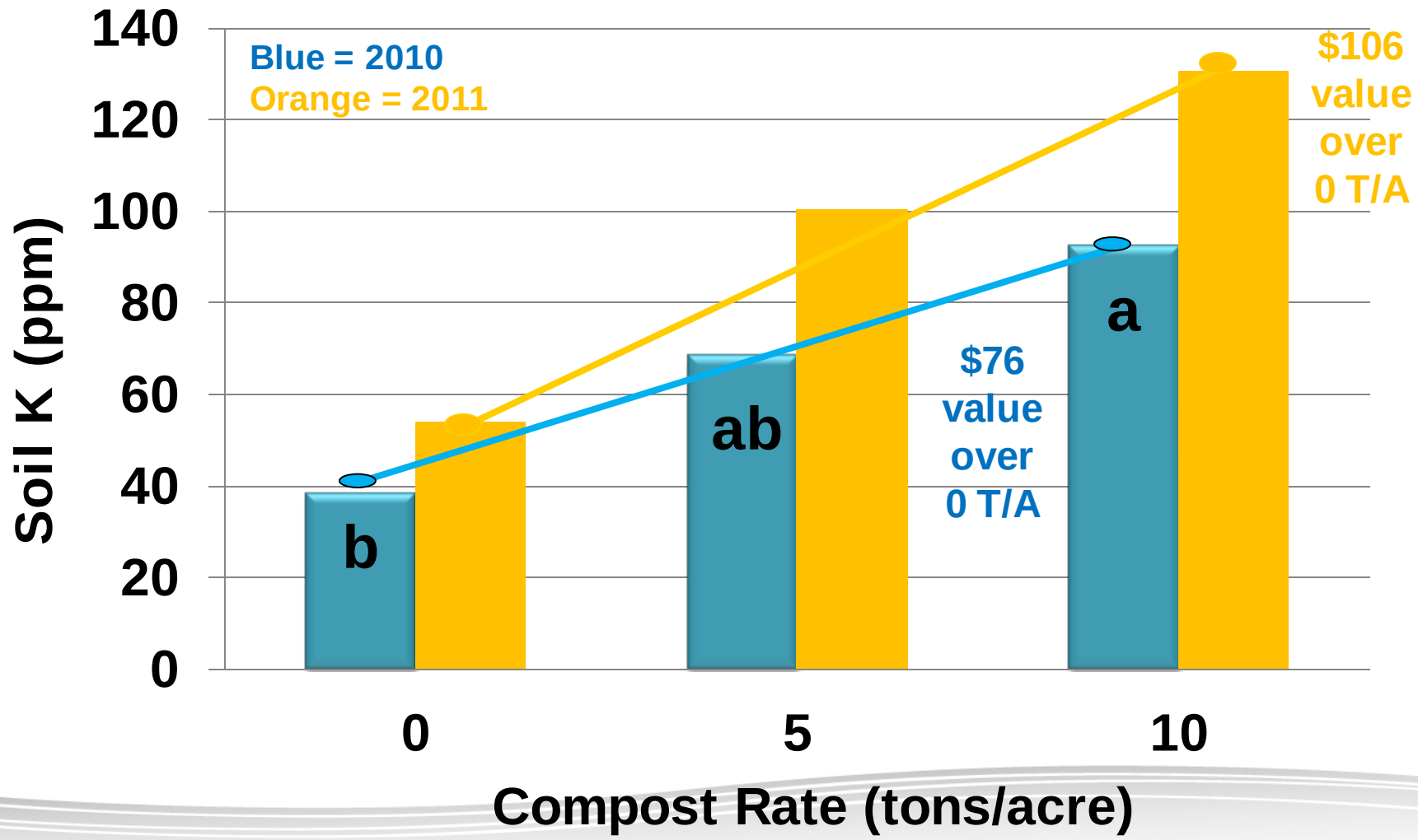
2010-11 Blaine Residual Soil K



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Preliminary Summary

- P mineralization with 5 and 10 T/A compost were double the control
- Use 10 T/A to increase K mineralization, and build soil residual K levels
- Use 5 T/A to increase P mineralization, and build soil residual P levels
- Economically effective to use dairy compost on dryland organic alfalfa/barley system

Value: Compost & Manure

- Slow release fertilizer
- Incorporating sustainable practices for soil health and nutrient holding capacity
- Better use of an abundant resource
- Economic value varies with nutrient content of compost or manure

Nutrient Source	$	Management	N,P,K	Provide OM
Synthetic Fertilizer		Short-term	High	No
Dairy Compost		Long-term	Medium -High	Yes

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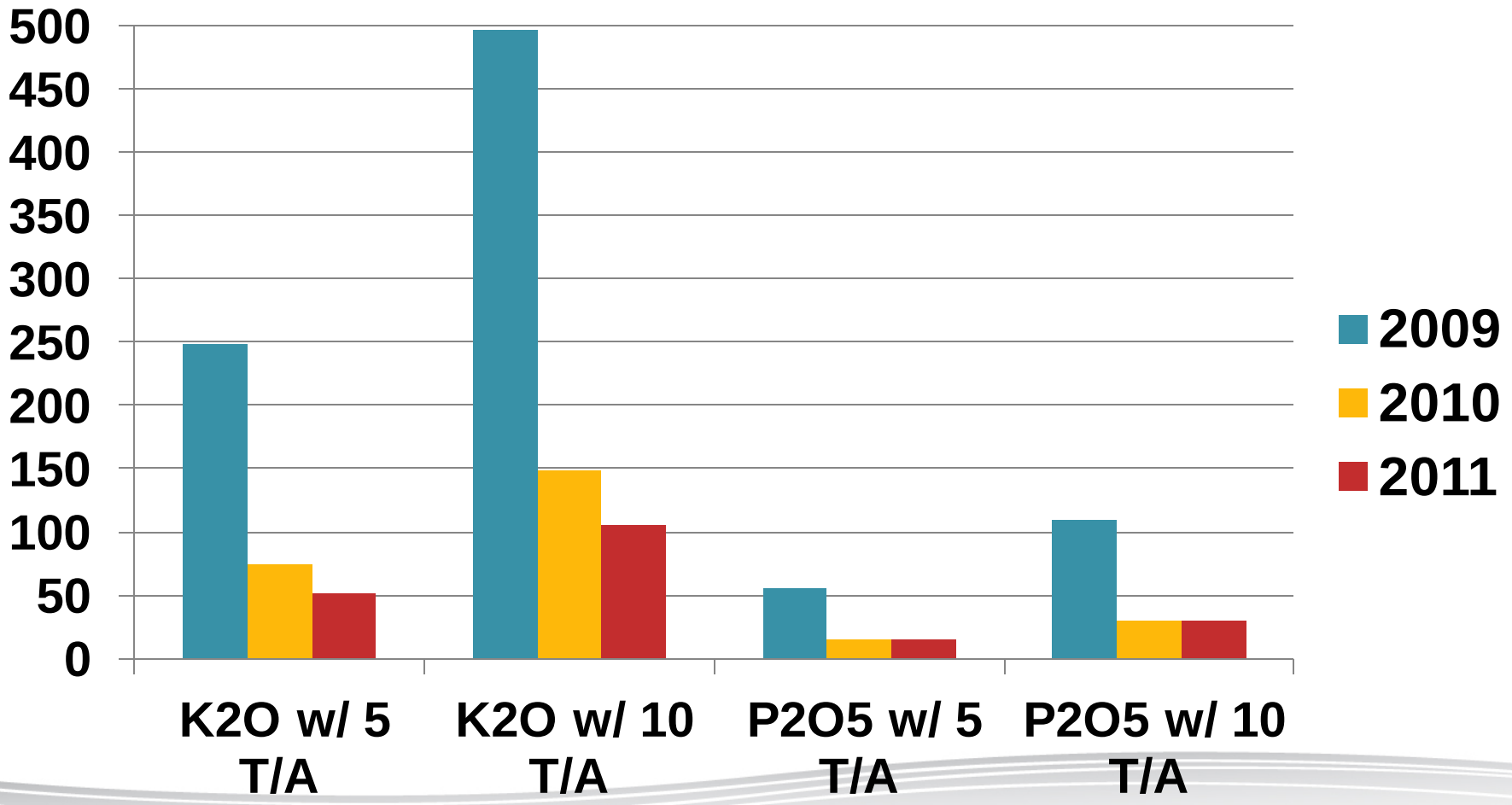
Blaine Compost P &K Content



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Economic Benefit of Compost - Example

Nutrient	Compost Nutrient lb/Ton	Fert. unit cost	Nutrient value/T of compost
2009 P_2O_5	11	$0.82	$9.02
2009 K_2O	50	$0.69	$34.50
2009			$43.52
2010 P_2O_5	3	$0.82	$2.46
2010 K_2O	15	$0.69	$10.35
2010			$12.81

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Economic Benefit of Compost - Example

Nutrient	Compost Nutrient lb/Ton	Fert. unit cost	Nutrient value/T of compost
Nitrogen - urea	14.5	$0.80	$11.60
P_2O_5	12.0	$0.82	$9.84
K_2O	26.0	$0.69	$17.94
Elemental S	3.0	$0.55	$1.65
1 ton	Compost	value	$41.03

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Economic Benefit of Compost - Example

Compost Rate	Compost Cost & Spreading	NPKS value	Savings from Compost
1 ton/acre	$25.00	$41.03	$16.03
5 ton/acre	$125.00	$205.15	$80.15
10 ton/acre	$250.00	$410.03	$160.30

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Compost in field crops should be part of any long-term soil management plan.

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QUESTIONS?

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Research Objectives

1. Increase knowledge on the use of dairy composted manure for organic and conventional systems in S. Idaho.
2. Evaluate macro-nutrient contribution from compost (N,P,K).
   a. Understand local mineralization rates
   b. Understand resulting residual soil nutrients

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Research Objectives

3. Evaluate economic$ of this management practice

4. Help growers better match crop nutrient demand to compost nutrient release.

5. Evaluate changes in soil quality(OM).

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Compost Supplemental Source of N

In Organic systems combine with:

- ✓ N fixing cover crops
- ✓ Organic fertilizers
- ✓ Manure

In Conventional systems combine with:

- ✓ Synthetic fertilizer
- ✓ Cover crops
- ✓ Manure

Variation Issues

- Powers et al. (1975) reported minimum and maximum values on a dry basis of animal