

Phosphorus Fertilizers, or *MAP and DAP*

Adapted from IPNI materials by

Larry Oldham, Ph.D.

Extension Professor – Soils



Ammoniated phosphate fertilizers

- } Ammoniated phosphates formed from the reaction of phosphoric acid (ortho- or poly) with ammonia.**
- } First major U.S. production about 1920 (MAP).**
- } About 1954 DAP major production initiated.**
- } Manufacture of the third member of the group, ammonium polyphosphates (APP, 10-34-0, 11-37-0), began in earnest in the late 1950's.**
- } APP are usually fluid, while MAP and DAP are granular.**

DAP (Diammonium phosphate)

- } Single recognized grade in the world marketplace is 18-46-0. Lower analyses may not be sold as DAP.**
- } Basic process for production involves ammoniation of phosphoric acid...
$$\text{H}_3\text{PO}_4 + 2\text{NH}_3 \rightarrow (\text{NH}_4)_2\text{HPO}_4$$**
- } Requires relatively low impurity phosphoric acid.**
- } Higher acid quality requirement is becoming a greater issue as phosphate rock (PR) quality declines, particularly in Florida.**

MAP (Monoammonium phosphate)

- } There is no single commodity grade for MAP. Can vary... 10-50-0, 11-51-0, 11-55-0, and others.**
- } Basic process for production involves ammoniation of phosphoric acid...
$$\text{H}_3\text{PO}_4 + \text{NH}_3 \rightarrow (\text{NH}_4)\text{H}_2\text{PO}_4$$**
- } Lower quality, high impurity phosphoric acid can be used in MAP production.**
- } Thus, manufacture is favored where PR quality is declining.**

MAP Supplies a Predominance of H_2PO_4^- ions...



From another reference:

Ammonia formation from DAP

} The high pH soil solution in combination with high pH soils and extra ammonia added to DAP can result in zones of free ammonia.

These areas in the soil could cause seed germination problems, seedling injury and potentially interfere with root development.

Phosphorus Uptake

} P is taken up from soil solutions by roots in two forms: H_2PO_4 and HPO_4 . Research has shown a trend that plants take up H_2PO_4 more rapidly than HPO_4 . This factor is important in the MAP-DAP comparison, because **the acid soil solution in MAP favors the formation of H_2PO_4 , thus more potential P uptake.**

MAP and DAP field comparisons

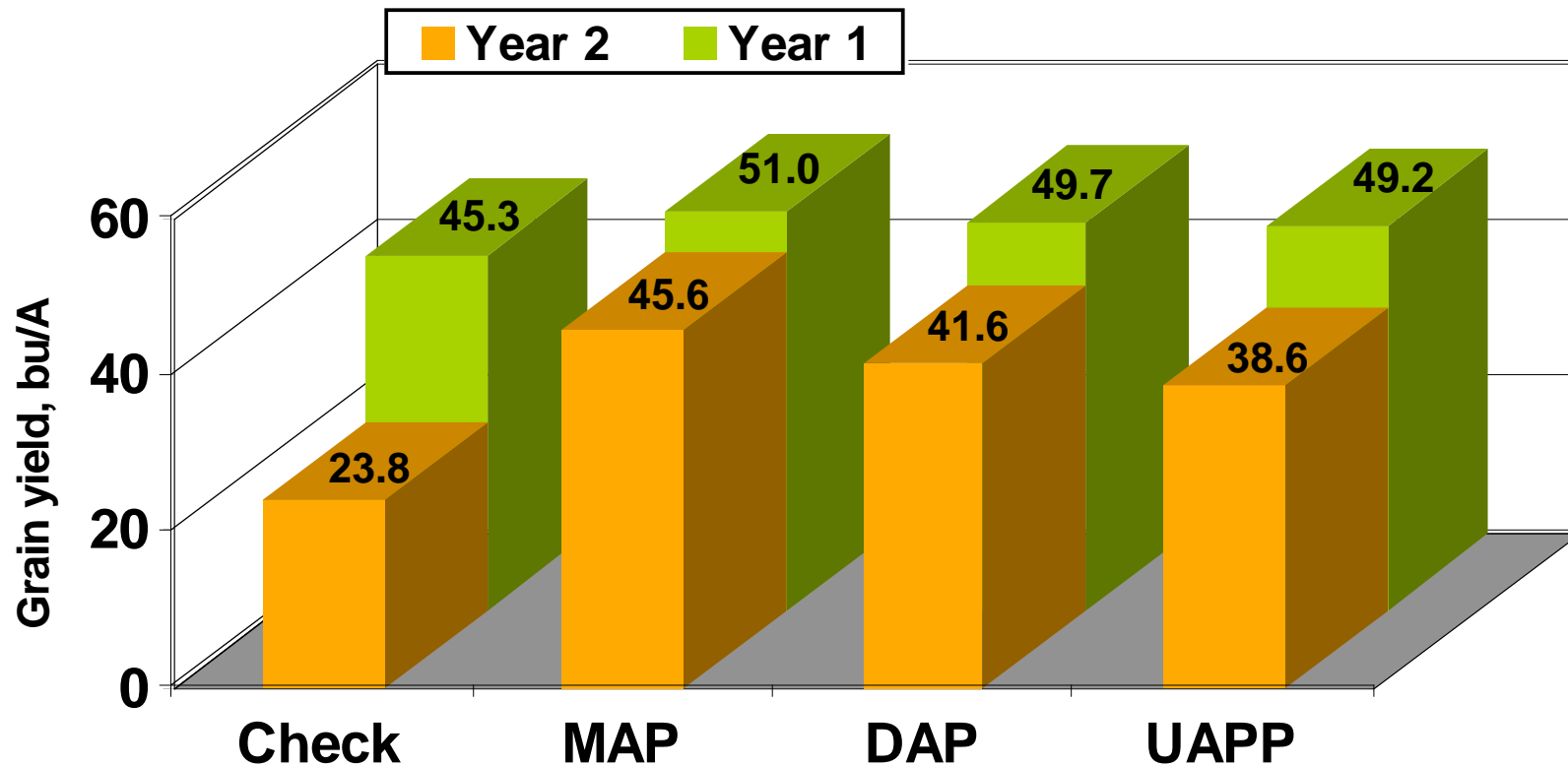


Wheat



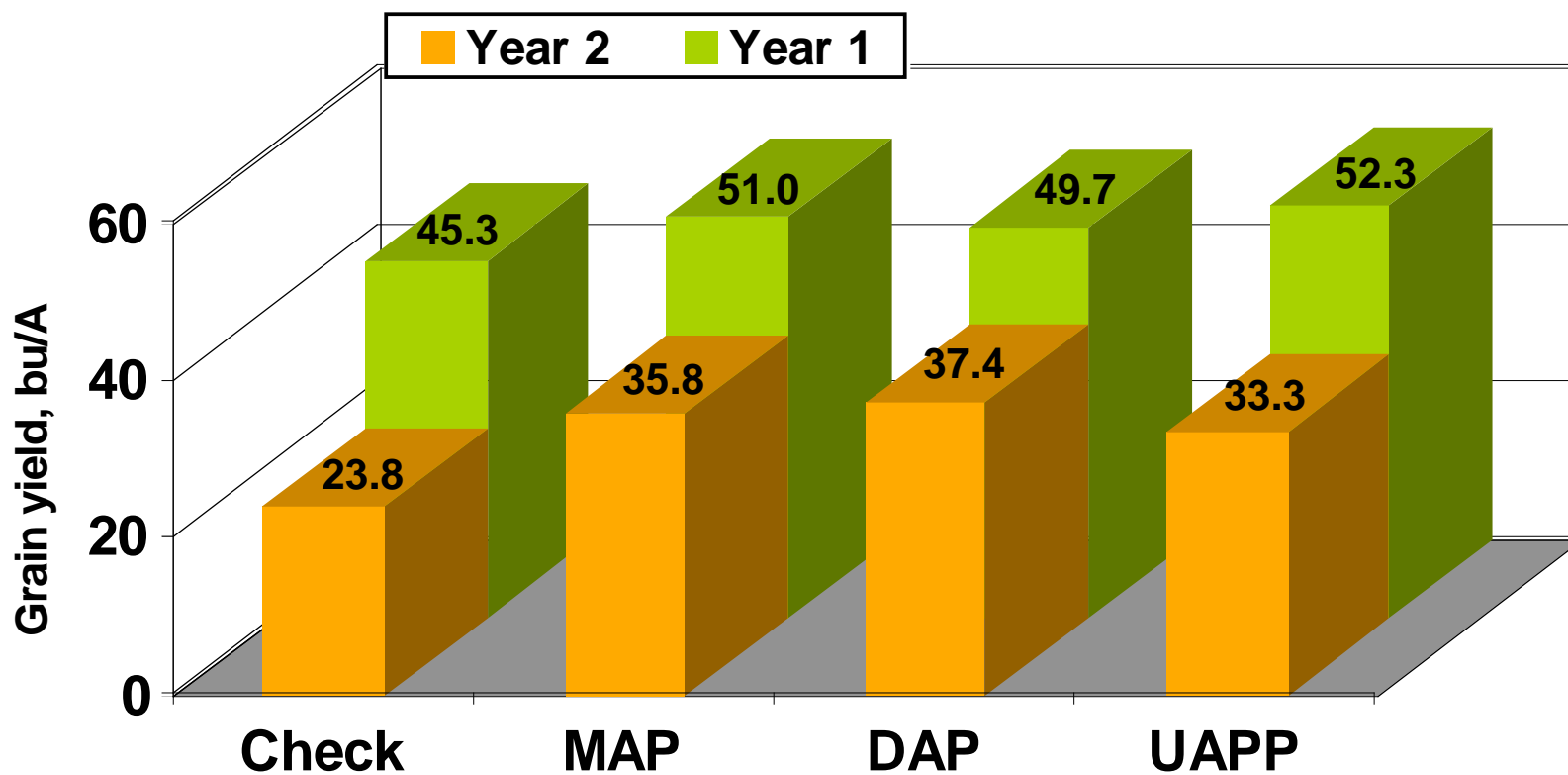
Kansas– Winter Wheat

Yield response to different sources of P– Broadcast



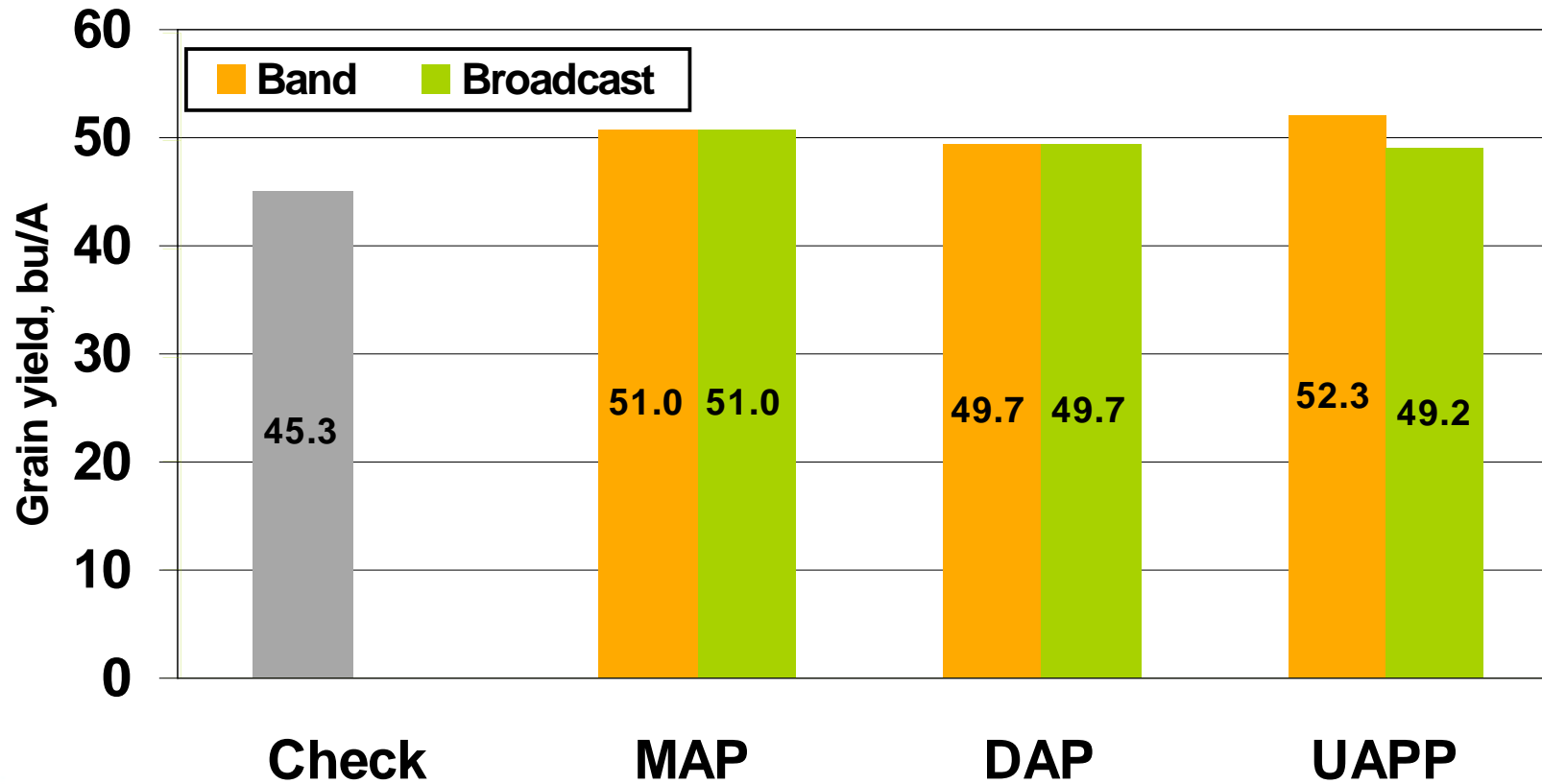
Kansas– Winter Wheat

Yield response to different sources of P– In-furrow



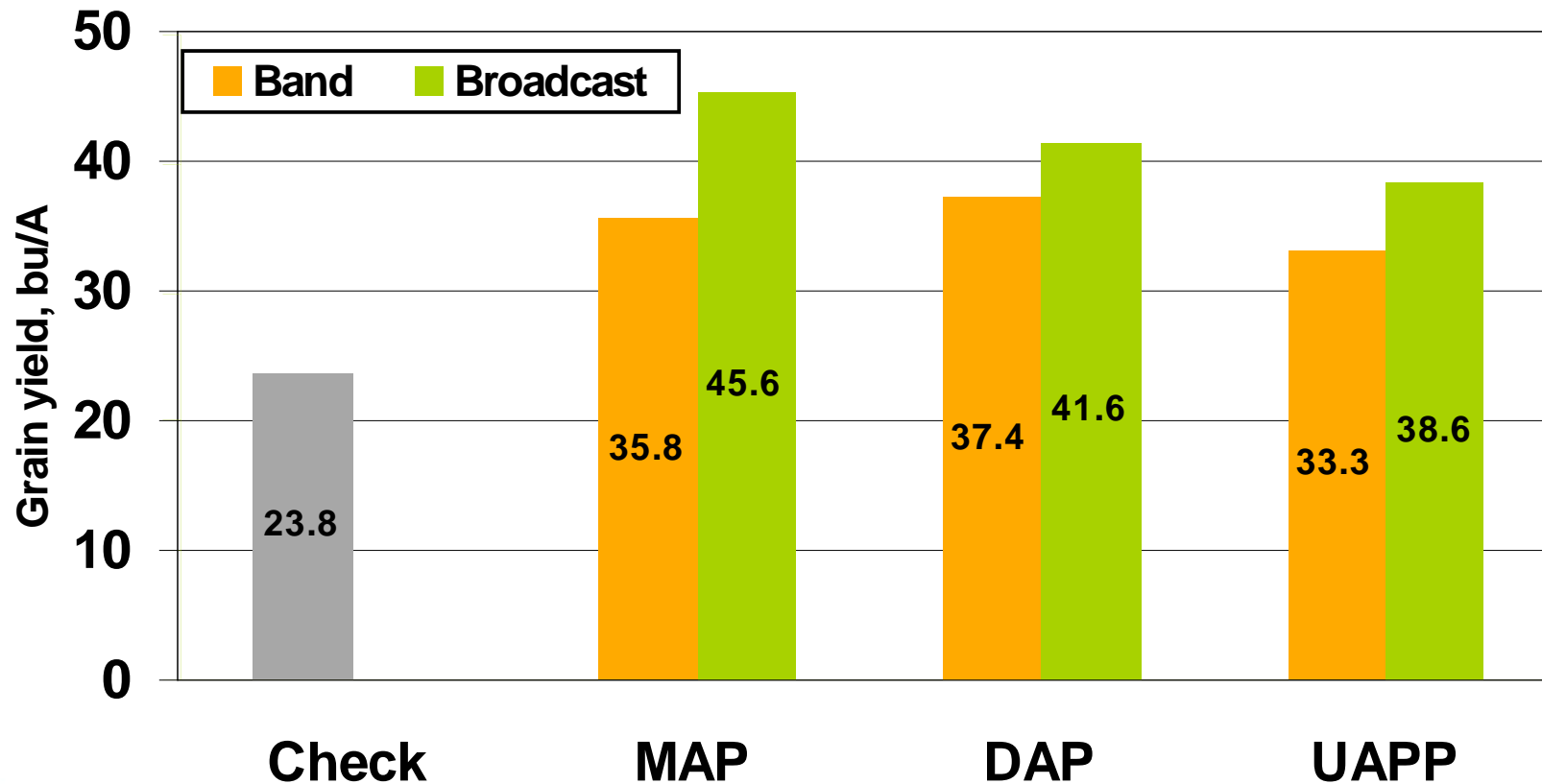
Kansas– Winter Wheat

Yield response to P source and placement (year one)



Kansas– Winter Wheat

Yield response to P source and placement (year two)

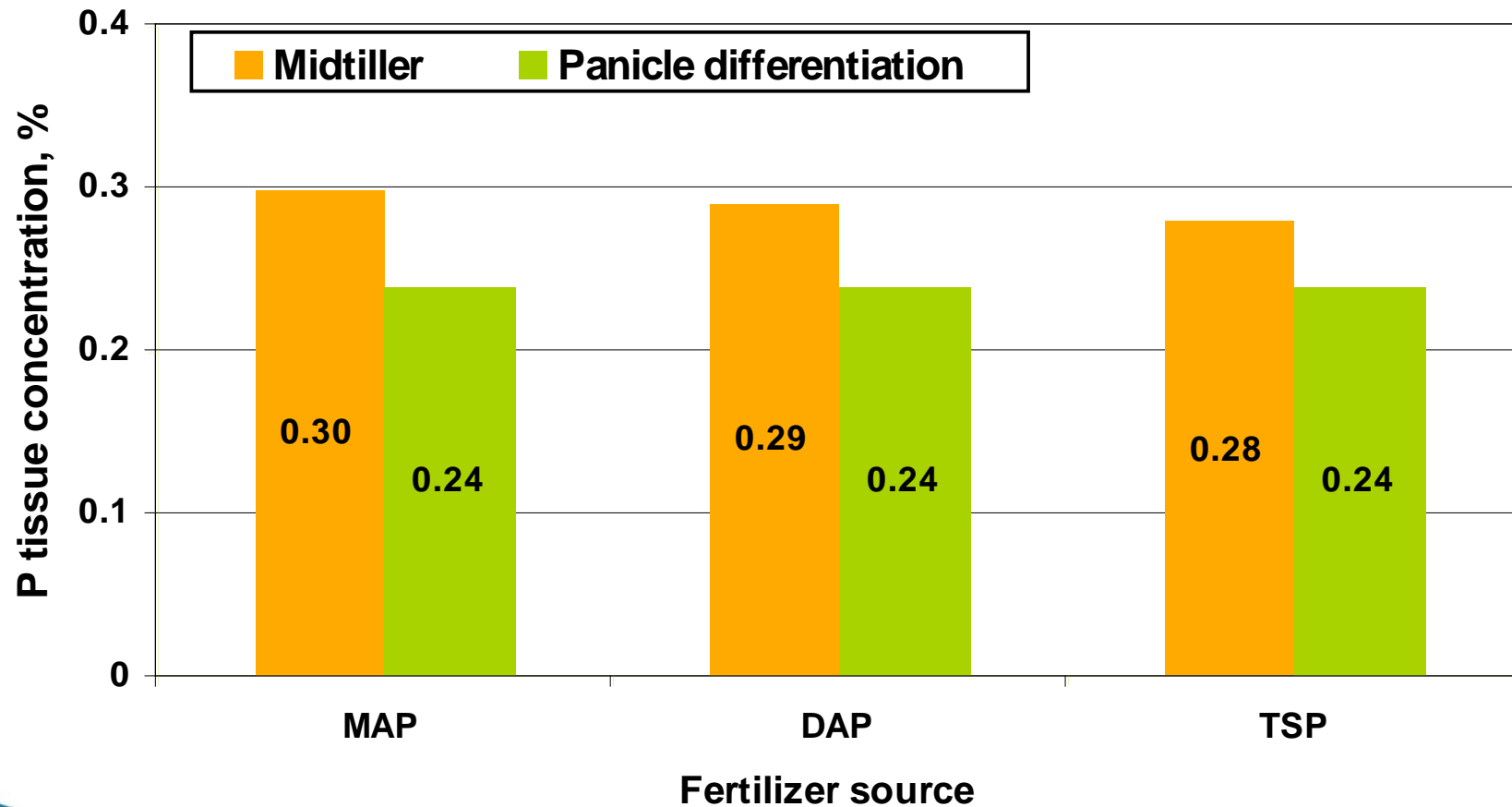


Rice



Arkansas– Rice

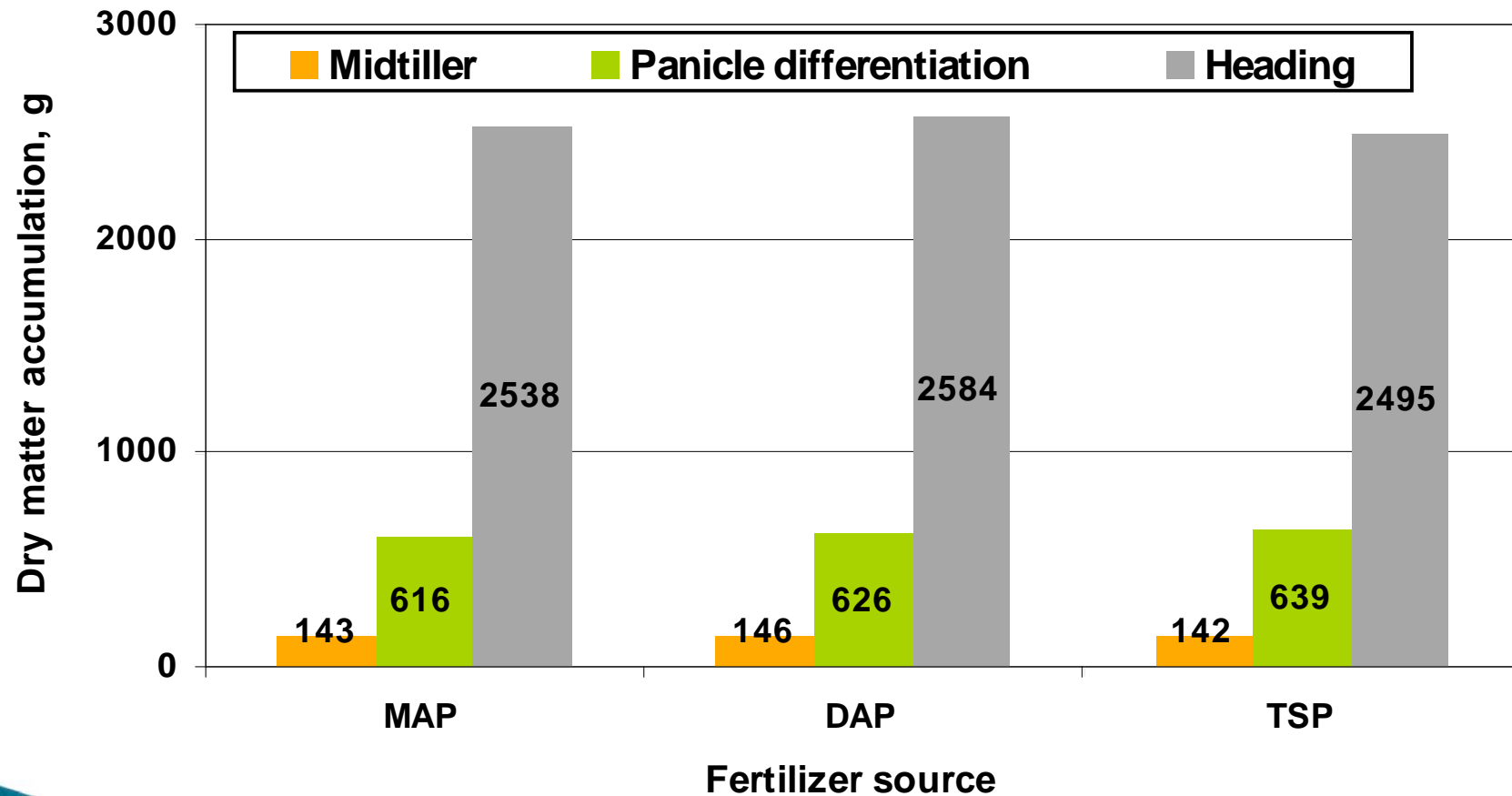
Effect of P source on P tissue concentration– Broadcast



Wilson et al.

Arkansas– Rice

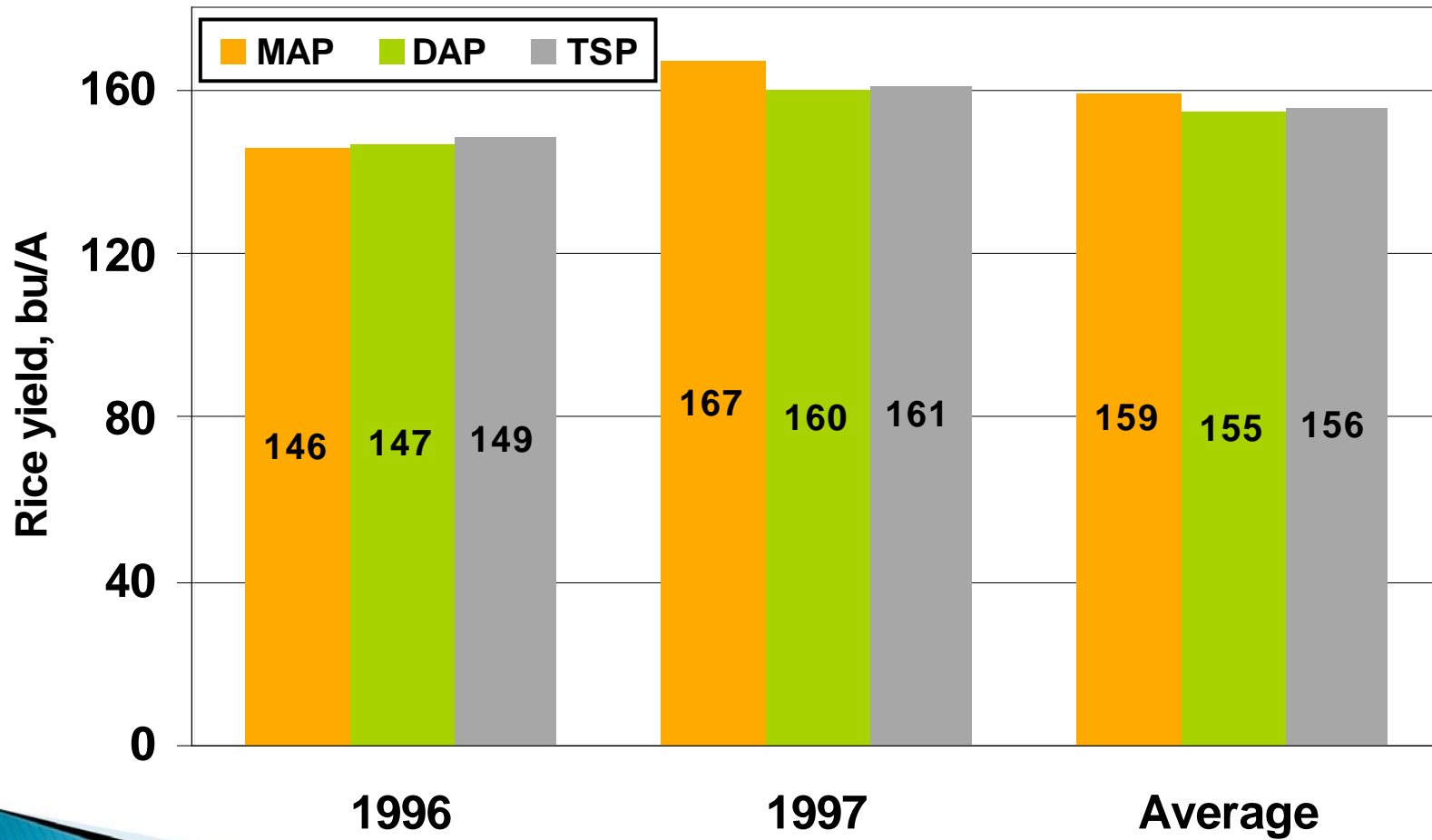
Effect of P source on dry matter accumulation– Broadcast



Wilson et al.

Arkansas– Rice

Yield response to various sources of P– Broadcast



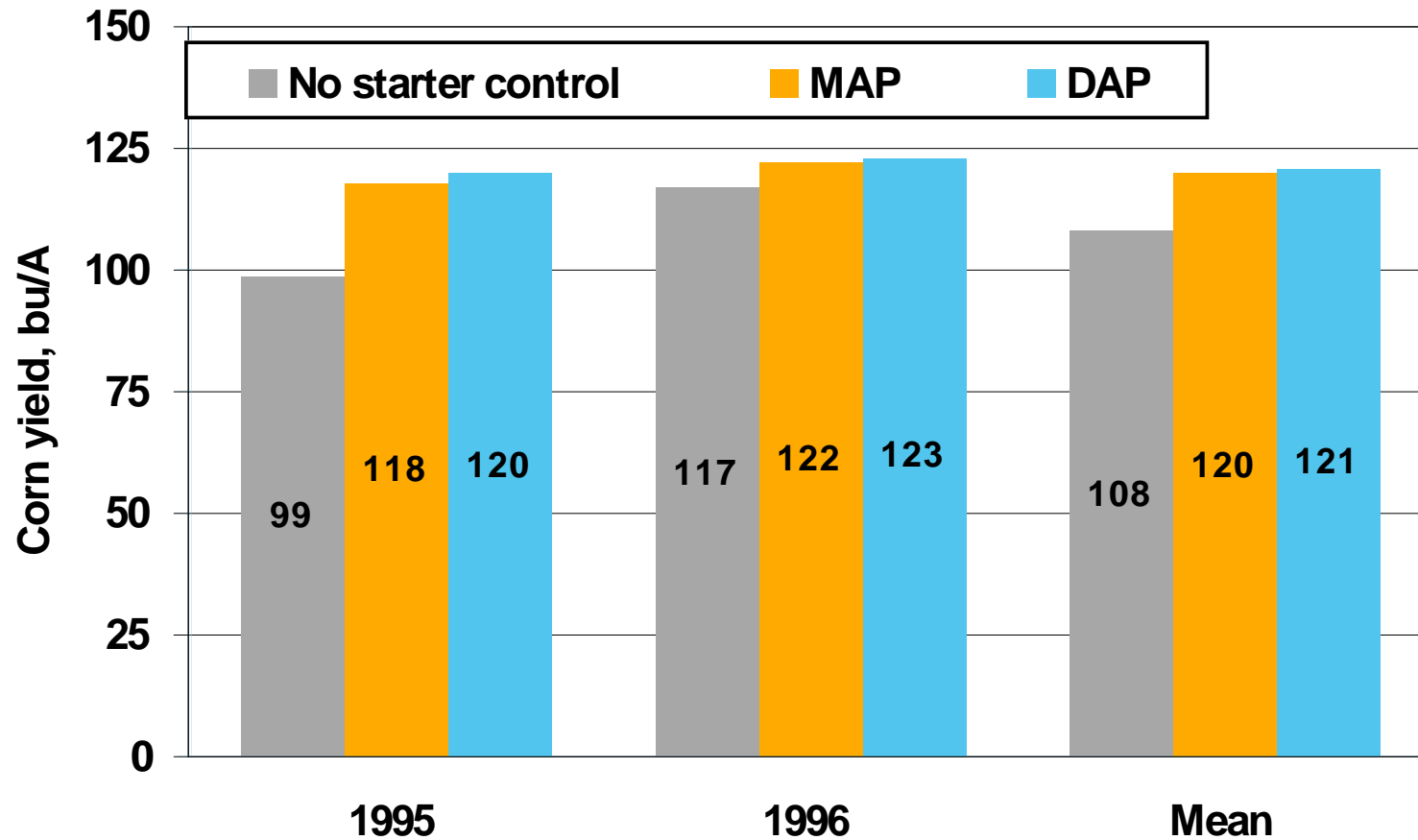
Wilson et al.

Corn and soybean



Wisconsin- Corn

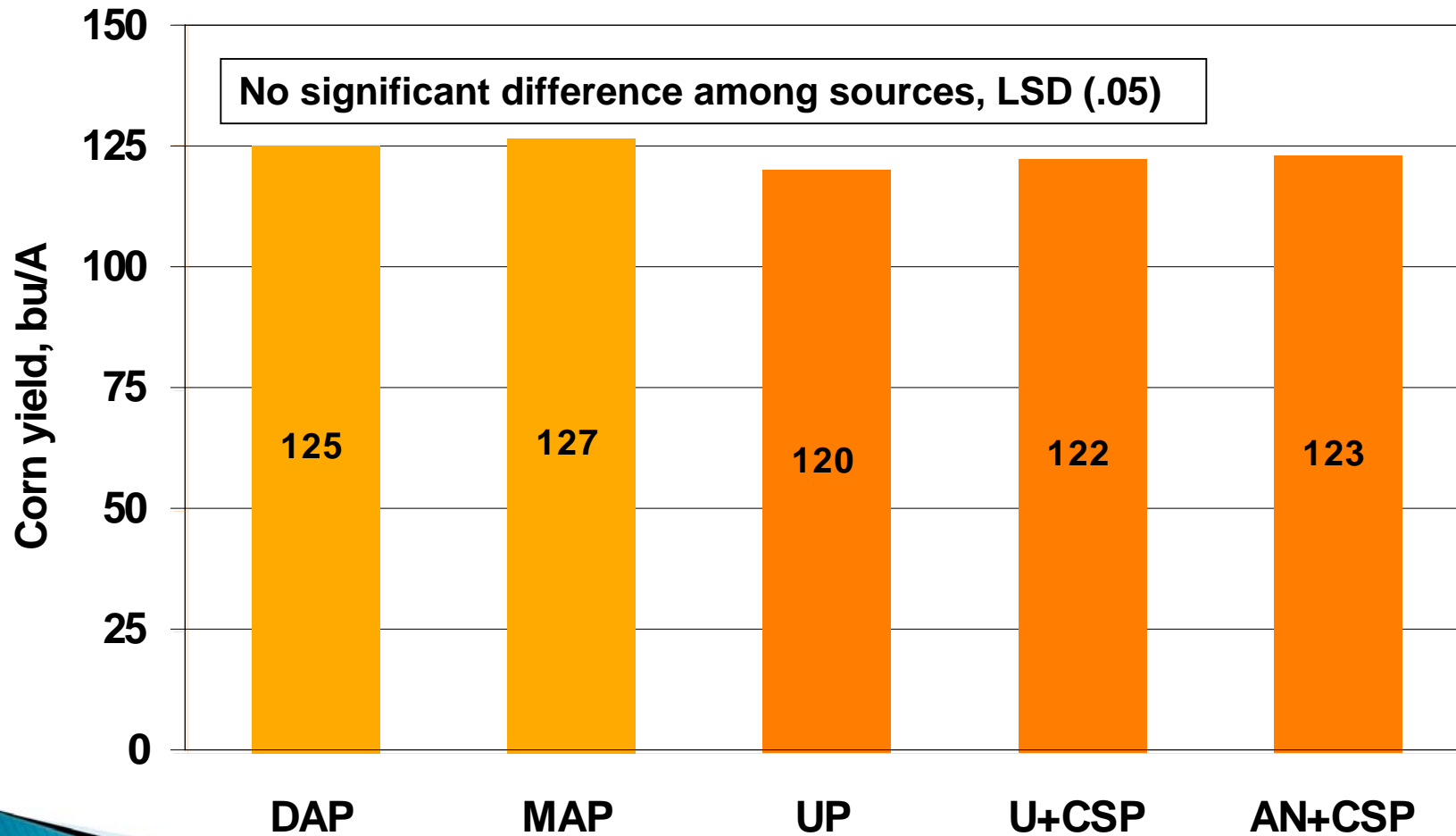
Effect of P source on corn yield- starter (2x2)



Rankin, M.

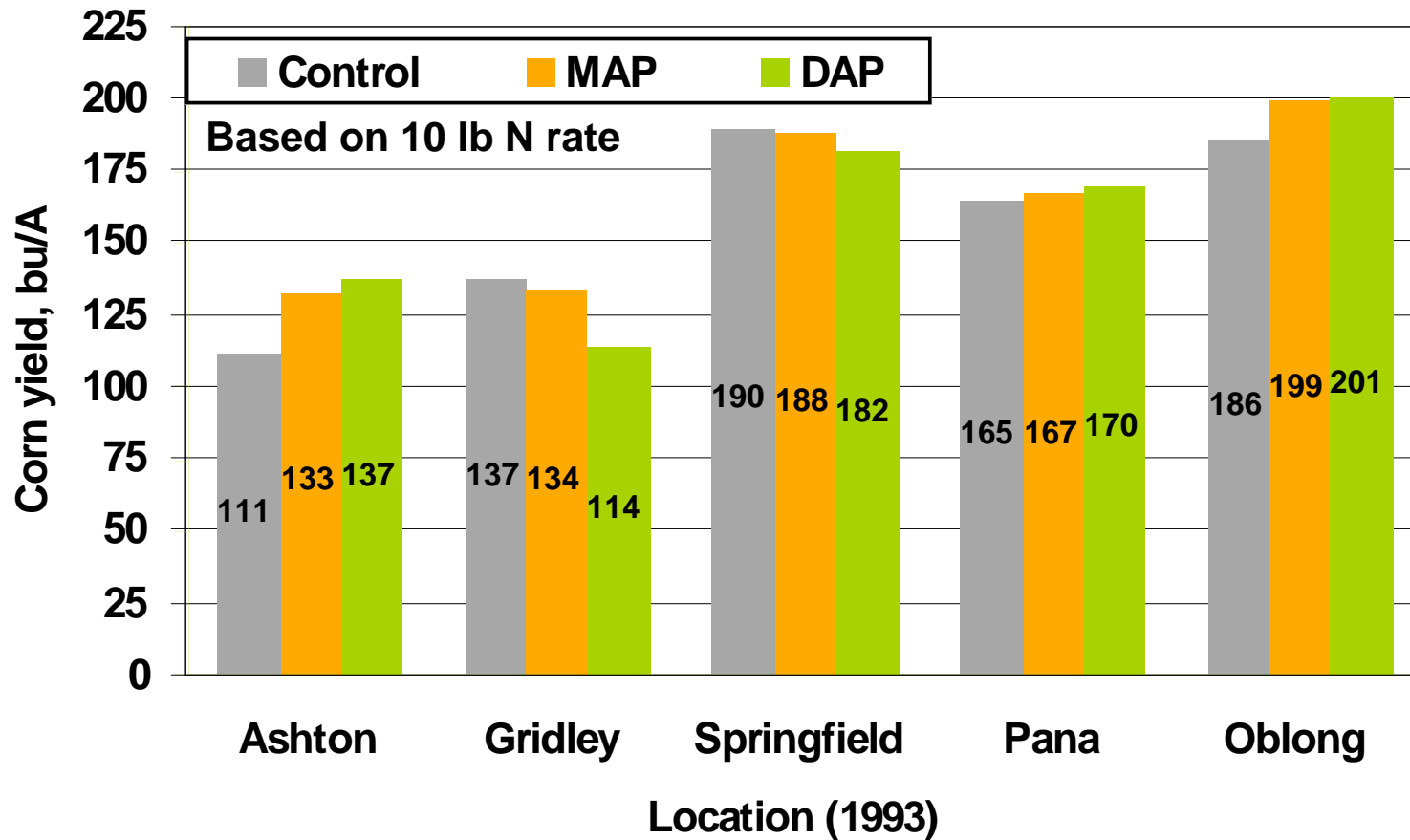
Michigan– Corn

Average response to various sources of P– Banded 2x2



Illinois- Corn

Effect of P source on corn yield at multiple locations- In-furrow



Minnesota– Corn

Effect of source (N), timing,
and rate on corn yield–
Broadcast

Study objectives:
To determine the
availability of N to
corn from fall and
spring applied DAP,
MAP, and AS

Parameter	Yield
	<i>bu/A</i>
<u>Source:</u>	
MAP	136.6
DAP	135.0
AS	137.7
<u>Time:</u>	
Fall	127.0
Spring	145.8
<u>N rate:</u>	
0	89.3
40	129.6
80	143.2

Practical summary

- } The initially acid reaction zone ($\text{pH} \leq 4$) of MAP:**
 - Helps prevent initial formation of toxic levels of ammonia**
 - Promotes precipitation of potentially favorable metastable reaction products, especially in alkaline soils.**
 - Increases potential P transport rate across root cell membranes**



Practical summary

- } The initially alkaline reaction zone ($\text{pH} \geq 8$) of DAP:**
 - Increases potential for ammonia toxicity to seeds or seedlings; can be managed by limiting rate applied in seed contact**
 - Results in precipitation of relatively insoluble apatite but also other potentially favorable metastable reaction products, especially in acid soils**
 - Solubilizes organic matter believed to increase movement of P away from the granule site**
 - Reduces potential P transport rate across cell membranes**

Practical summary

- } Differences in reaction zone characteristics between MAP and DAP diminish with time ... usually becoming **minor within a month or two.**
- } The majority of field comparisons of MAP and DAP in the published technical literature conducted using typical farmer practices show only minor yield differences, if any, due to P source effects.
- } Recent development of new P fertilizers and additives is increasing the number of field P source comparisons in today's farming systems.

Thank You!



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