



United States Department of Agriculture

Keys to alfalfa establishment in high yielding silage corn



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Corn silage and alfalfa are often grown in rotation to provide forage for livestock, but low yields of spring-seeded alfalfa reduce profitability

Rotation: **Corn – corn – spring seeded alfalfa – alfalfa – alfalfa**

Forage dry matter yields

Corn silage: 9 t per acre

Established alfalfa: 5 t per acre

Spring seeded alfalfa: 3 t per acre



Excessive corn silage production also causes problems...

- **High risk of soil and nutrient loss**
- **Without crop rotation, corn silage yields decline and input costs for fertilizer and pesticides increase**



Possible solution: Interseed alfalfa into corn to protect soil and jumpstart full alfalfa production the following year

- Alfalfa planted into corn interrows
- Corn silage harvested, alfalfa remains as a cover crop
- Following year(s) alfalfa harvested as a forage crop



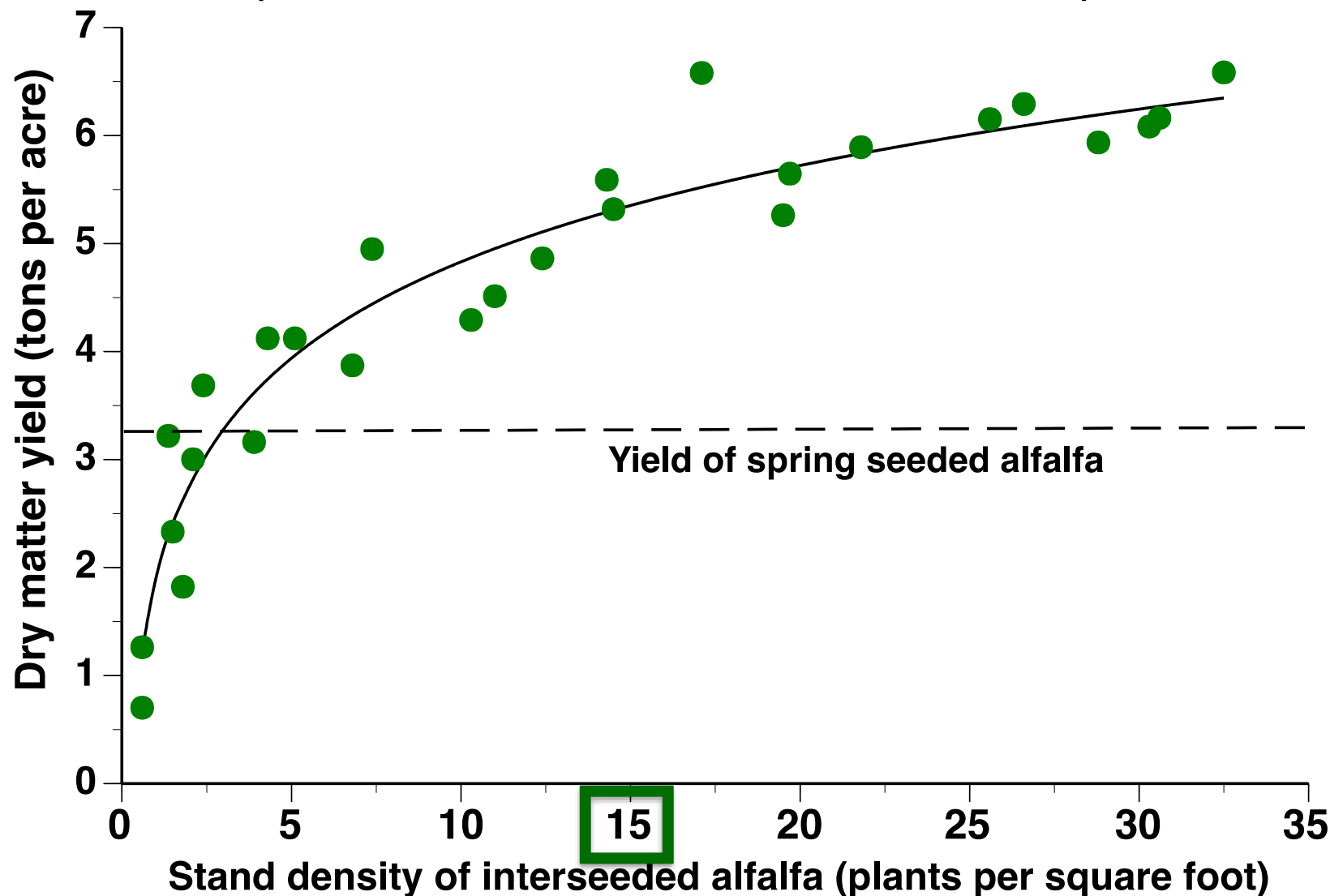
Problem: Interseeded alfalfa is prone to stand failure



Objective: Develop reliable, productive, and profitable interseeded alfalfa-corn silage production systems

Goal: Want >15 alfalfa plants per square foot after corn silage harvest to maximize 1st year yields of alfalfa

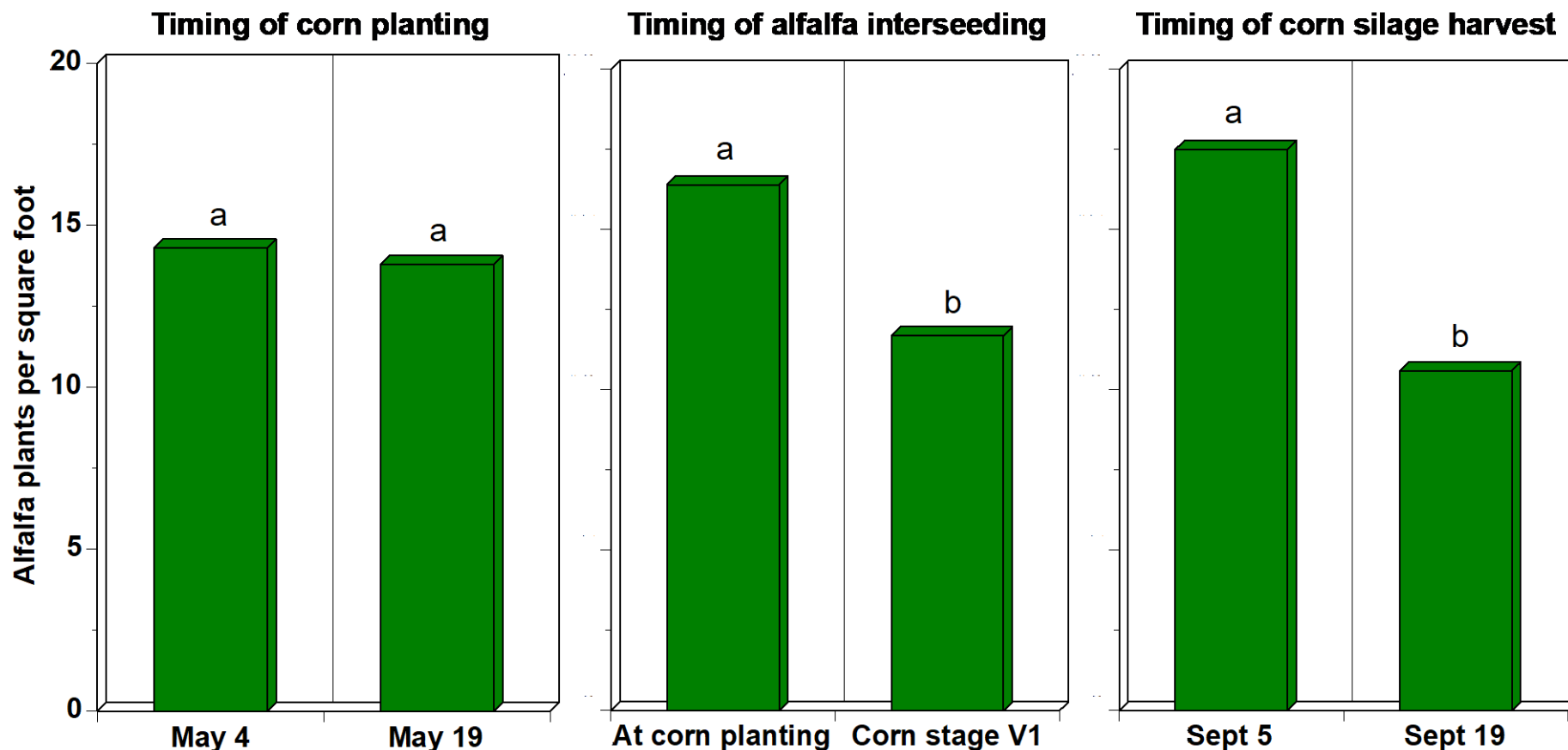
(2018 and 2019 data from Prairie du Sac, Wisconsin)



**Impact of management
practices on
establishment and
forage yields of
interseeded alfalfa**

Establishment of alfalfa favored by early interseeding and early corn harvest, but not influenced by timing of corn planting

Requires further study



Alfalfa stand counts taken after corn silage harvest at Prairie du Sac, Wisconsin in 2017.

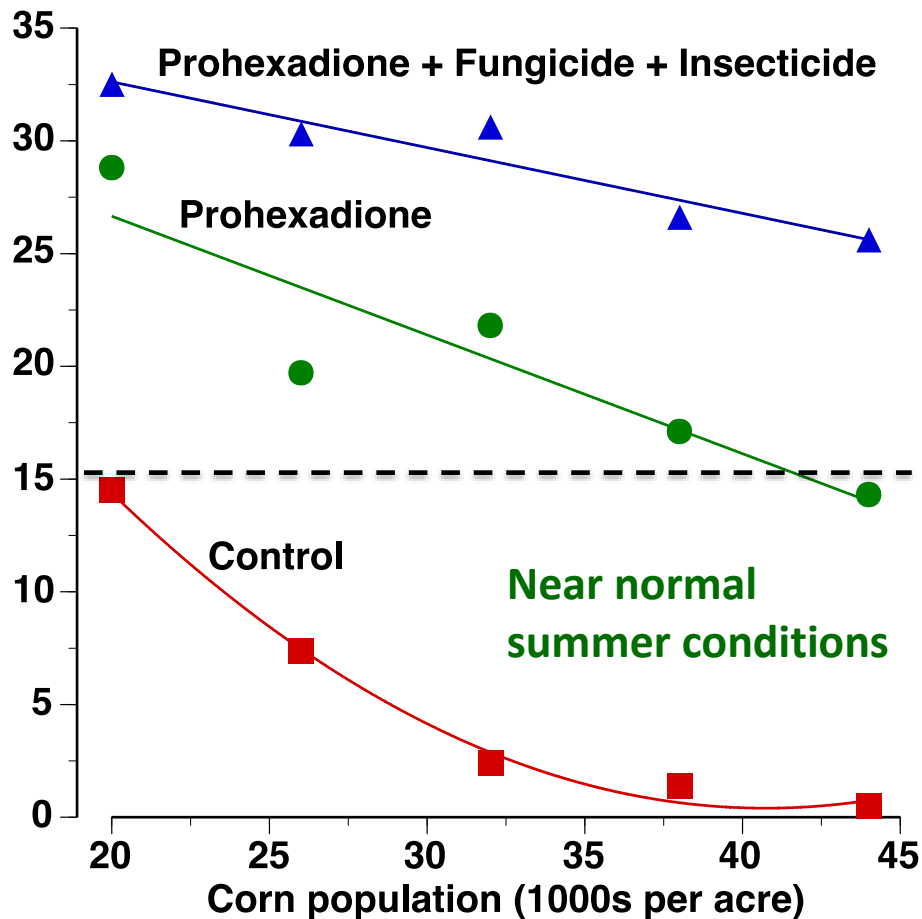
Treatments with unlike letters differ at $P = 0.05$

Prohexadione sprayed on alfalfa in June followed by fungicide and insecticide in July improves alfalfa establishment

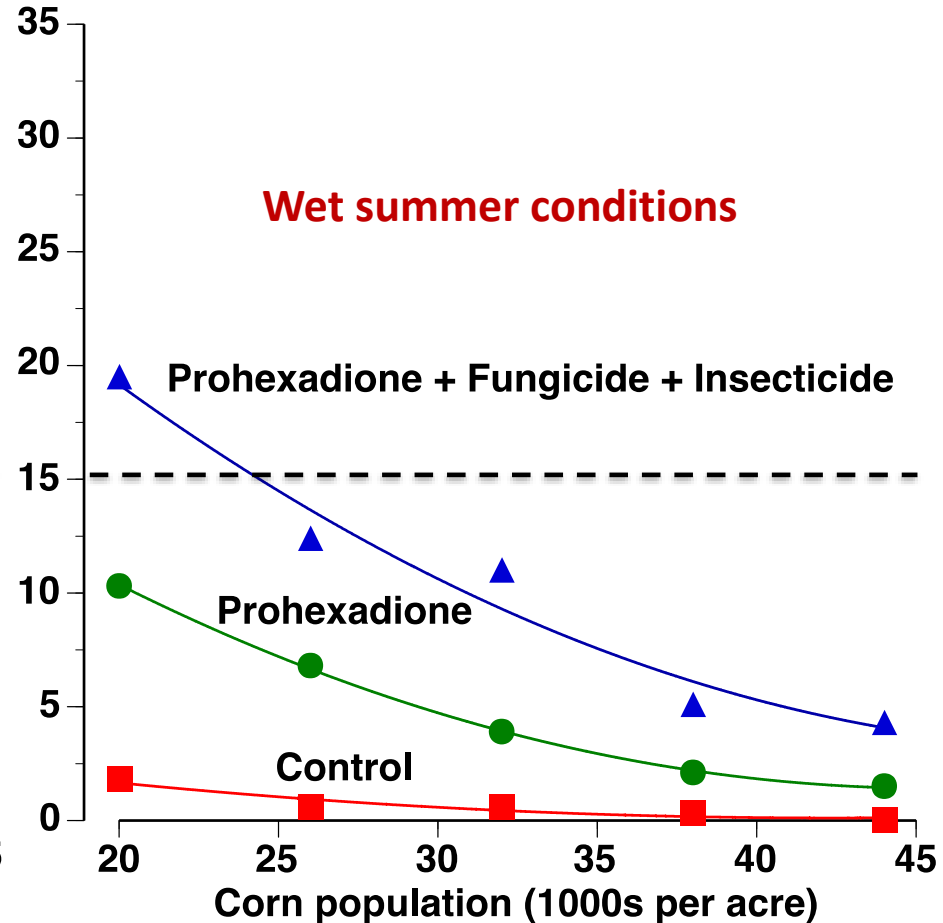
Data from Prairie du Sac, Wisconsin

Confirmed in other Wisconsin locations, but not always observed in other states

Alfalfa plants per sq ft after corn harvest in 2017



Alfalfa plants per sq ft after corn harvest in 2018

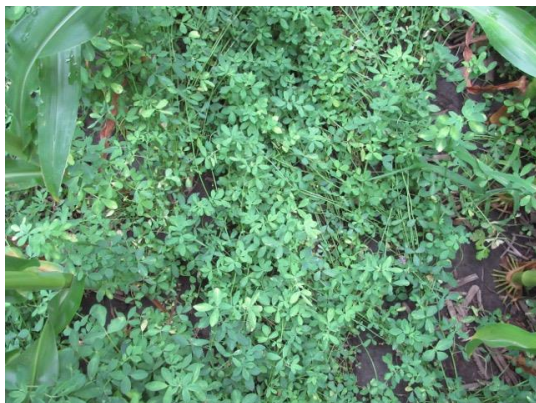


July

August

October

Control



Prohexadione

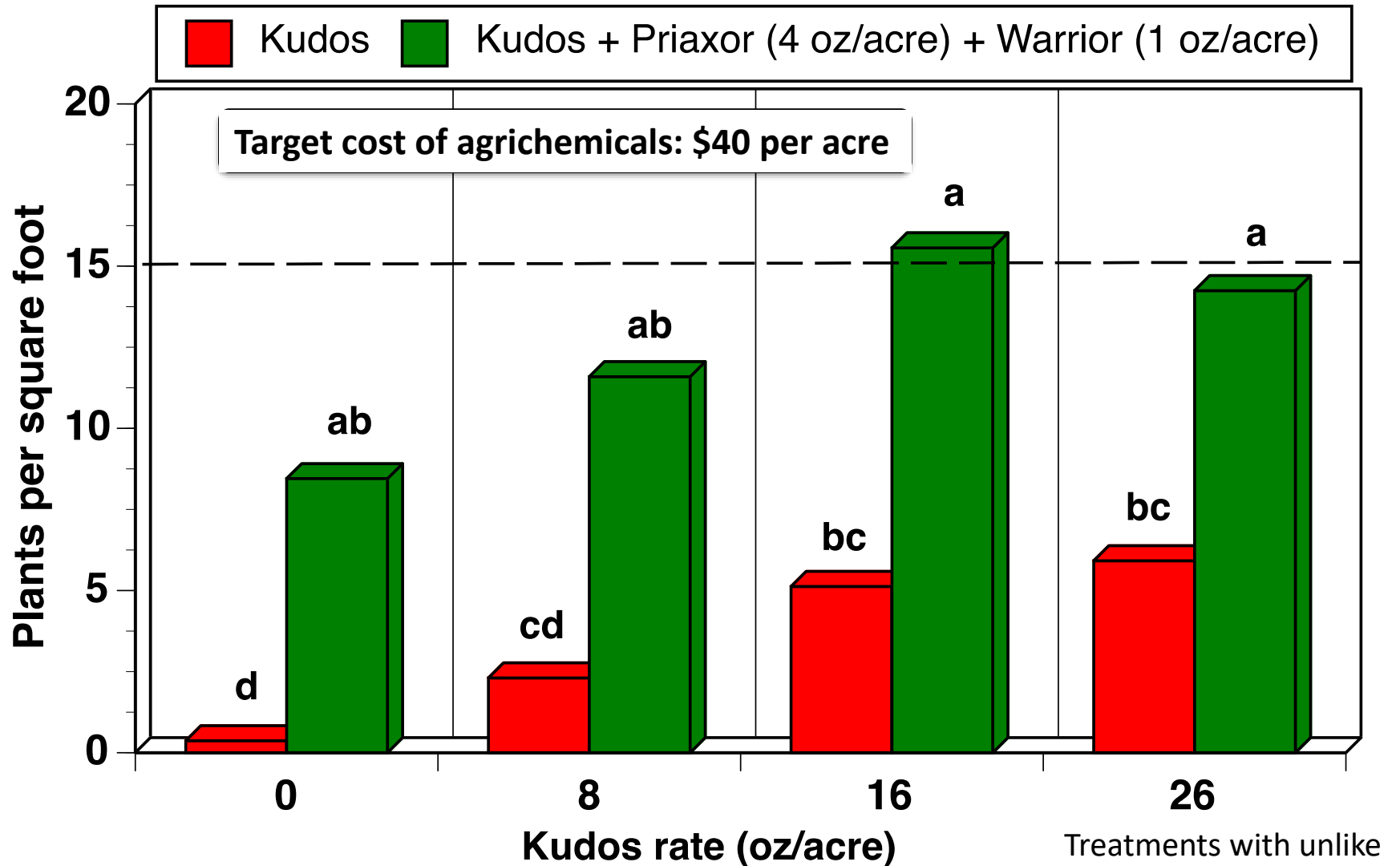


**Prohexadione
+ Fungicide +
Insecticide**



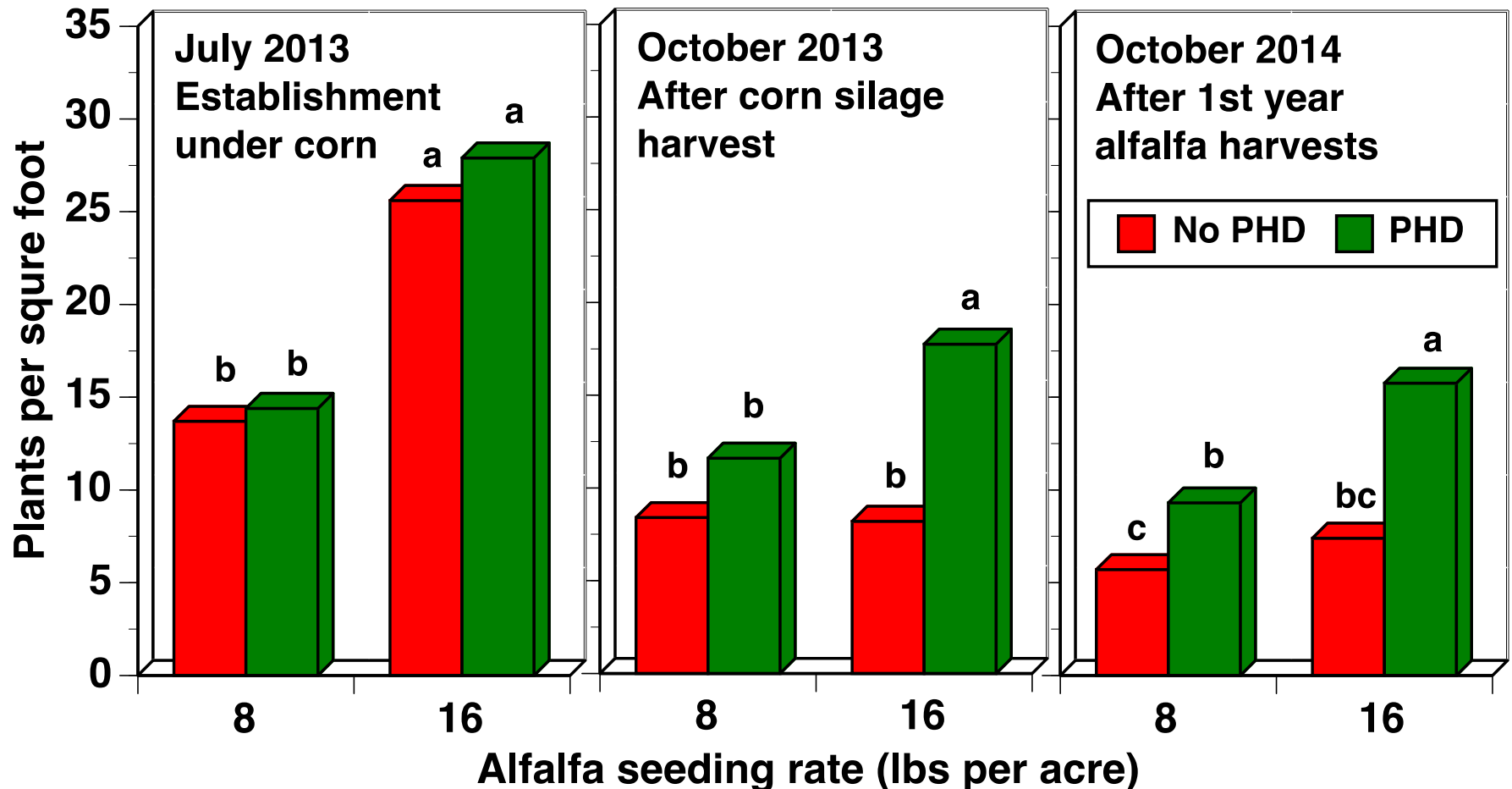
How much (Kudos) with fungicide (Priaxor) and insecticide (Warrior) are needed for alfalfa establishment?

Arlington, Wisconsin 2019. Requires further study



Treatments with unlike letters differ at $P = 0.05$

Drill alfalfa into a properly prepared seedbed, use normal alfalfa seeding rates, and treat seedlings with agrichemicals such as prohexadione (PHD)

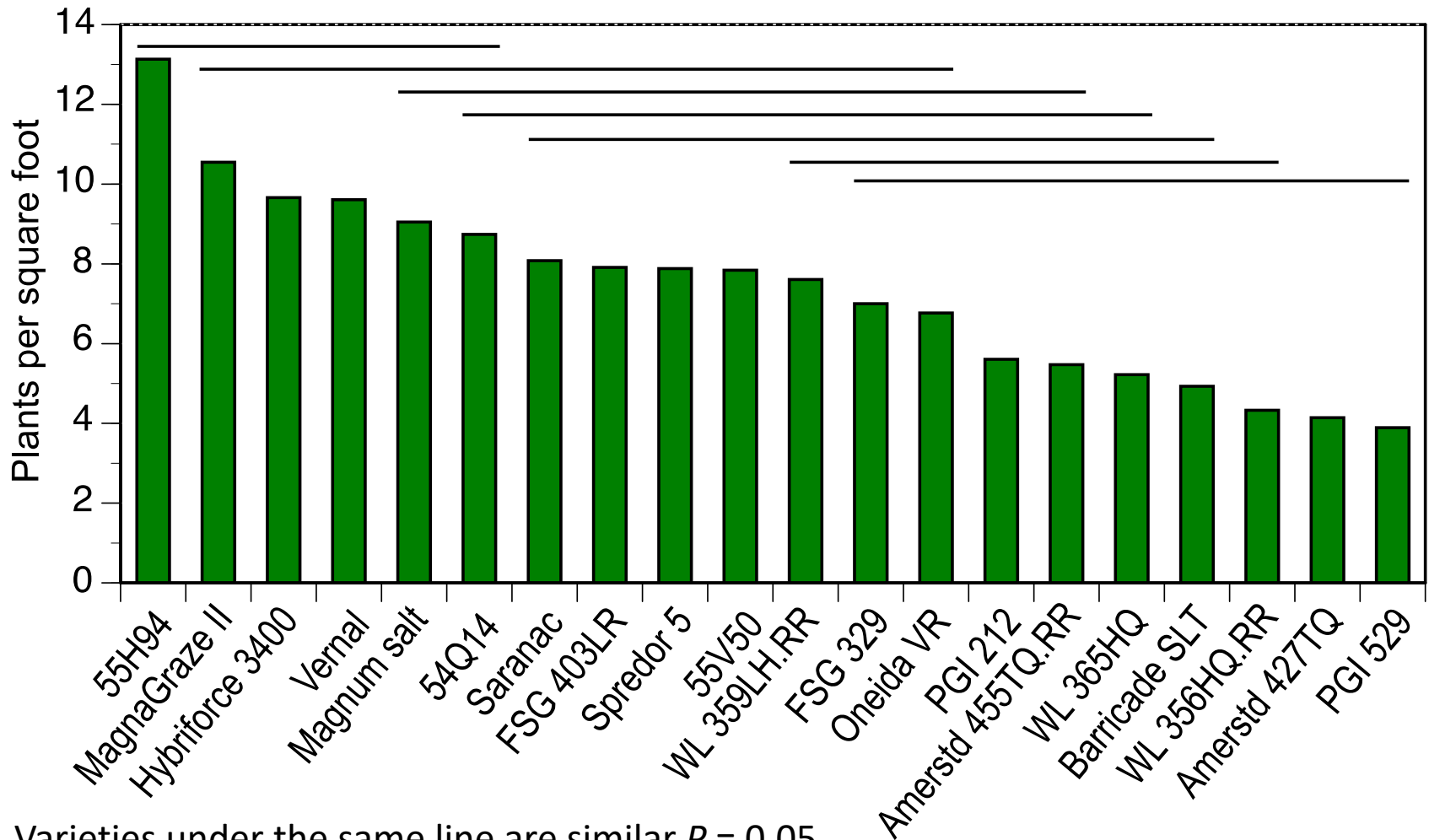


Treatments with unlike letters differ at $P = 0.05$

Grabber, J.H. Agronomy J. 108:726-735 (2016)

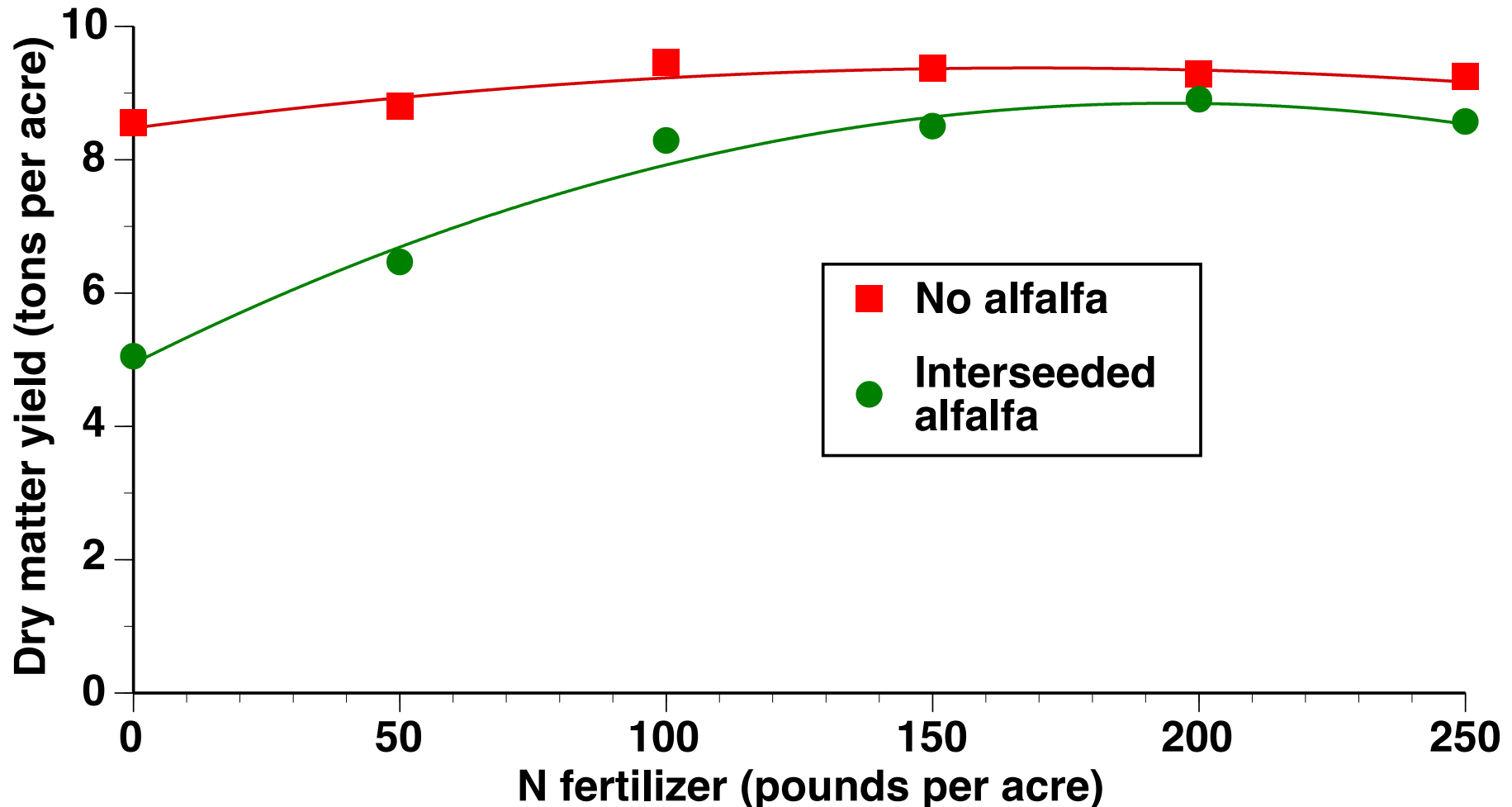
Use alfalfa varieties that are well-adapted for establishment under corn

Stand density after corn in 2016, averaged across two sites in Wisconsin
Confirmed in other Wisconsin studies, but not always observed in other states



Fertilize corn with adequate nitrogen fertilizer to maximize silage yield

Arlington, Wisconsin 2017. Fertilizer management requires further study



Use appropriate herbicides for controlling weeds in corn with interseeded alfalfa

Conventional alfalfa (Arlington, Wisconsin 2016)

Crop(s)	Herbicide treatment	Timing	Weed cover (%) 2 weeks after POST	Alfalfa cover (%) 2 weeks after POST
Corn + alfalfa	Warrant 3 pt/A + Buctril 2EC 1 pt/A	PRE + POST	2 c	89 a
Corn + alfalfa	Non-treated control	-	23 b	77 b
Corn	Non-treated control	-	67 a	-
			$P < 0.05$	$P < 0.05$

Herbicides often reduce weed cover to < 10% but avoid seeding in fields infested with summer annual grasses

Alfalfa interseeding partially suppresses weeds

Roundup-Ready alfalfa

Glyphosate reliably provides excellent weed control

Don't interseed...



...during a spring drought
(remember 2012!)



...into weedy, poorly drained,
acidic or infertile fields, or
poorly prepared seedbeds



Wet soil conditions at corn silage harvest in early September



Stand recovery by mid October

Photos by Brad Holtz

Minimize wheel traffic of alfalfa when chopping corn, especially on wet soil

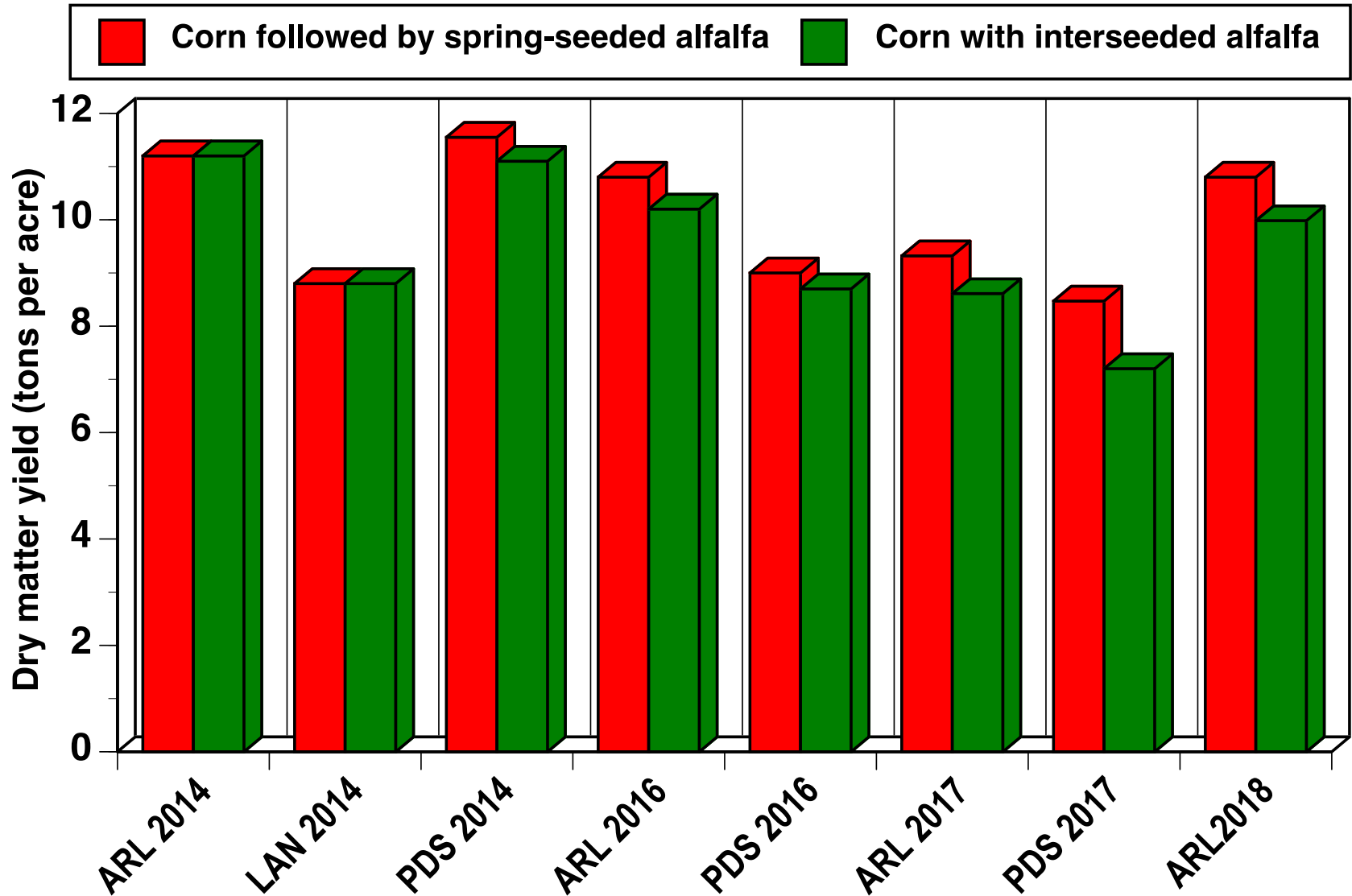


On wet soils, severe compaction from truck tires kills alfalfa

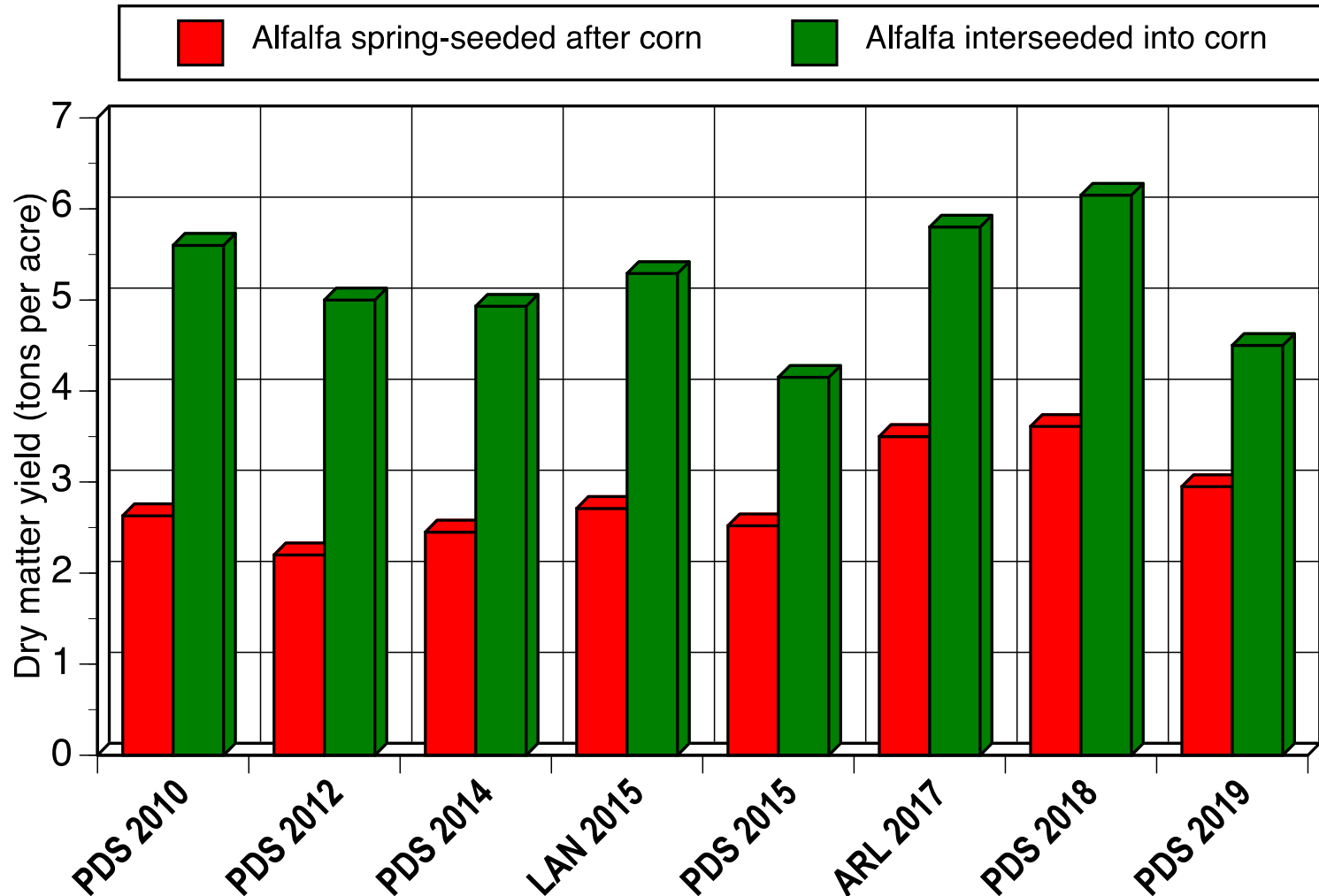
**What's the yearly variation
in yields for corn silage
and interseeded alfalfa?**

Alfalfa interseeding reduces corn silage yields in some environments, but not others. . . why?

Applied 200 lbs per acre nitrogen fertilizer

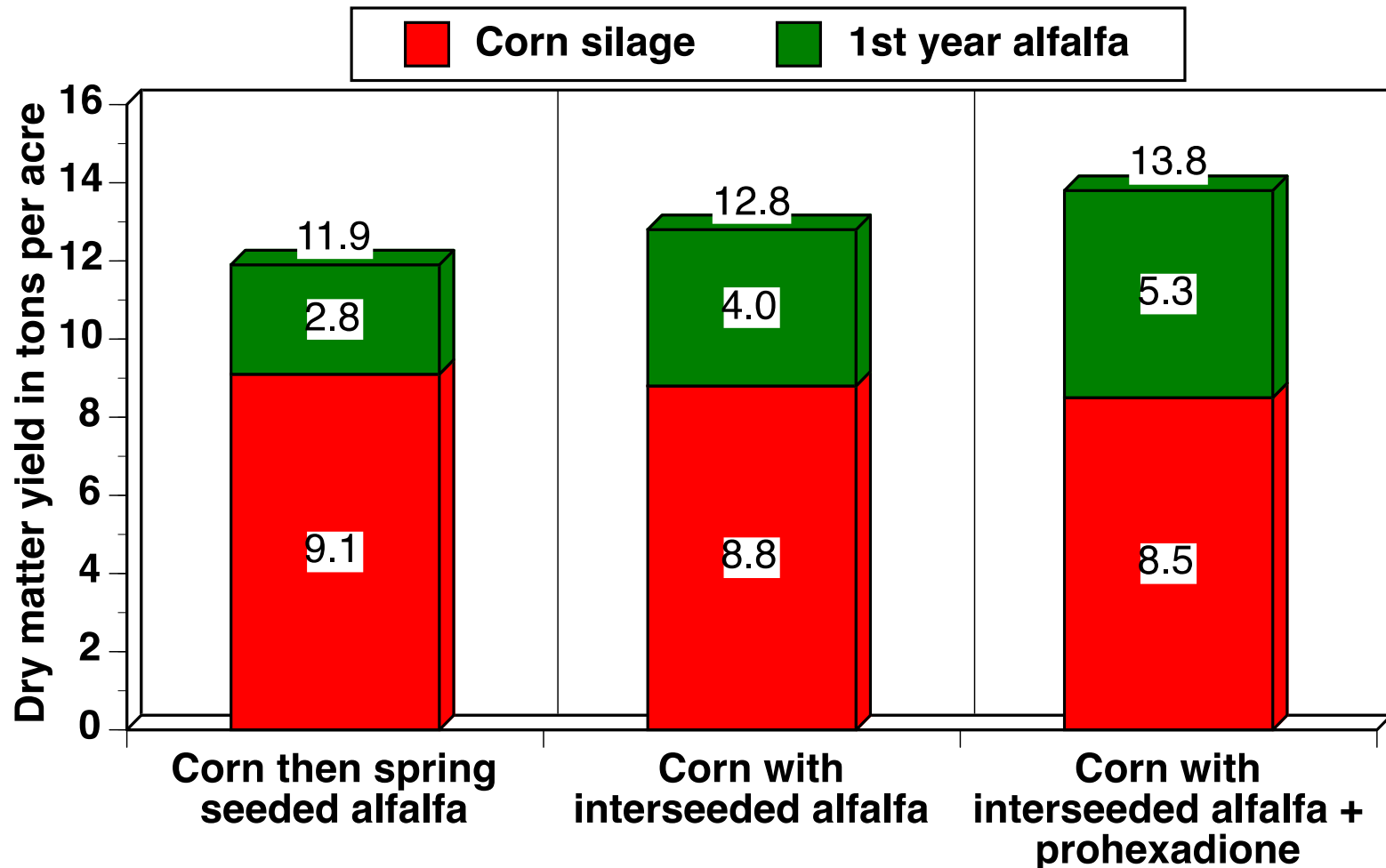


First year alfalfa yields are increased by 1.6 to 2.3-fold by successful interseeding into corn



Treatments differ at $P = 0.05$

Overall, successful alfalfa interseeding increases total dry matter yields of corn silage followed by 1st year alfalfa compared to conventional spring seeding of alfalfa



Alfalfa interseeded at corn planting on May 4th with corn harvest on Sept 19th in 2017.
Alfalfa was harvested 3-4X during 2018 at Prairie du Sac, Wisconsin.

**But will interseeding of
alfalfa be profitable?**

Switching from spring seeding to interseeding of alfalfa could increase average net returns of corn silage (CS)-alfalfa (A) rotations by about 12%

Most profitable rotation with spring seeding (8 years):

CS1-CS2-CS3-CS4-A1-A2-A3-A4
Net return averaged across rotation \$129 per acre per year

Most profitable rotation with interseeding (6 years):

CS1-CS2-CS3/A1-A2-A3-A4
Net return averaged across rotation \$144 per acre per year

Key assumptions:

- Interseeded alfalfa increases corn N requirements from 160 to 200 lbs per acre
- Interseeded alfalfa reduces corn silage yield by 5%, but doubles 1st year alfalfa yield
- \$48 per acre cost for applying agrichemicals to interseeded alfalfa
- 80% success rate for alfalfa establishment by interseeding

Summary of recommendations

- **Fields must have a suitable soil pH, fertility, drainage, and seedbed for alfalfa seeding and avoid weedy fields (esp. summer annual grasses)**
- **Apply manure and fertilizer to support growth of both corn and alfalfa**
- **Plant early- or mid-maturing corn hybrids at a final density of ~32,000 plants per acre (prefer hybrids with quick emergence, strong roots, and excellent stress/drought tolerance)**
- **0 to 10 days after corn planting, drill interseed alfalfa at 16 lbs/acre**
- **Don't interseed if soil moisture is very low and rainfall is not expected**
- **Apply herbicides, prohexadione, fungicide and insecticide (if needed) to promote alfalfa seeding survival and high corn yields**
- **Chop corn in early to mid September at correct moisture for silage.**
- **Avoid chopping when soils are wet, limit wheel tracking, and use low pressure tires (avoid using dump trucks in fields).**
- **Properly fertilize alfalfa with phosphorus, potassium, boron, etc to support forage production and stand longevity.**

Ongoing work

- **Identify best rates and timing for prohexadione, fungicide, and insecticide application on alfalfa**
- **Refine fertilizer, planting and harvest management**
- **Evaluate long-term survival and yield of interseeded alfalfa**
- **Identify hybrid traits needed to maximize corn silage yield**
- **Breed alfalfa for improved survival under corn**
- **Evaluate success of the interseeding system in different states**
- **Promote alfalfa interseeding to producers, industry, NRCS, crop insurance...**