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Intercropping alfalfa with corn silage

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Alfalfa - corn silage crop rotations are often grown in the northern USA

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

Low dry matter yields of spring seeded alfalfa reduces profitability

- **Established alfalfa: 5 t per acre**
- **Spring seeded alfalfa: 2.5 t per acre**
- **Corn silage: 9 t per acre**

Excessive cropping with corn silage

- High risk of soil and nutrient loss
- Yields decline, input costs increase



Alfalfa intercropped in corn silage can increase overall forage yields and the sustainability and profitability of forage production

Overview of the system

- Alfalfa planted between corn interrows during the last year of corn production
- Alfalfa serves as a cover crop during and after corn production
- Following years alfalfa harvested for forage

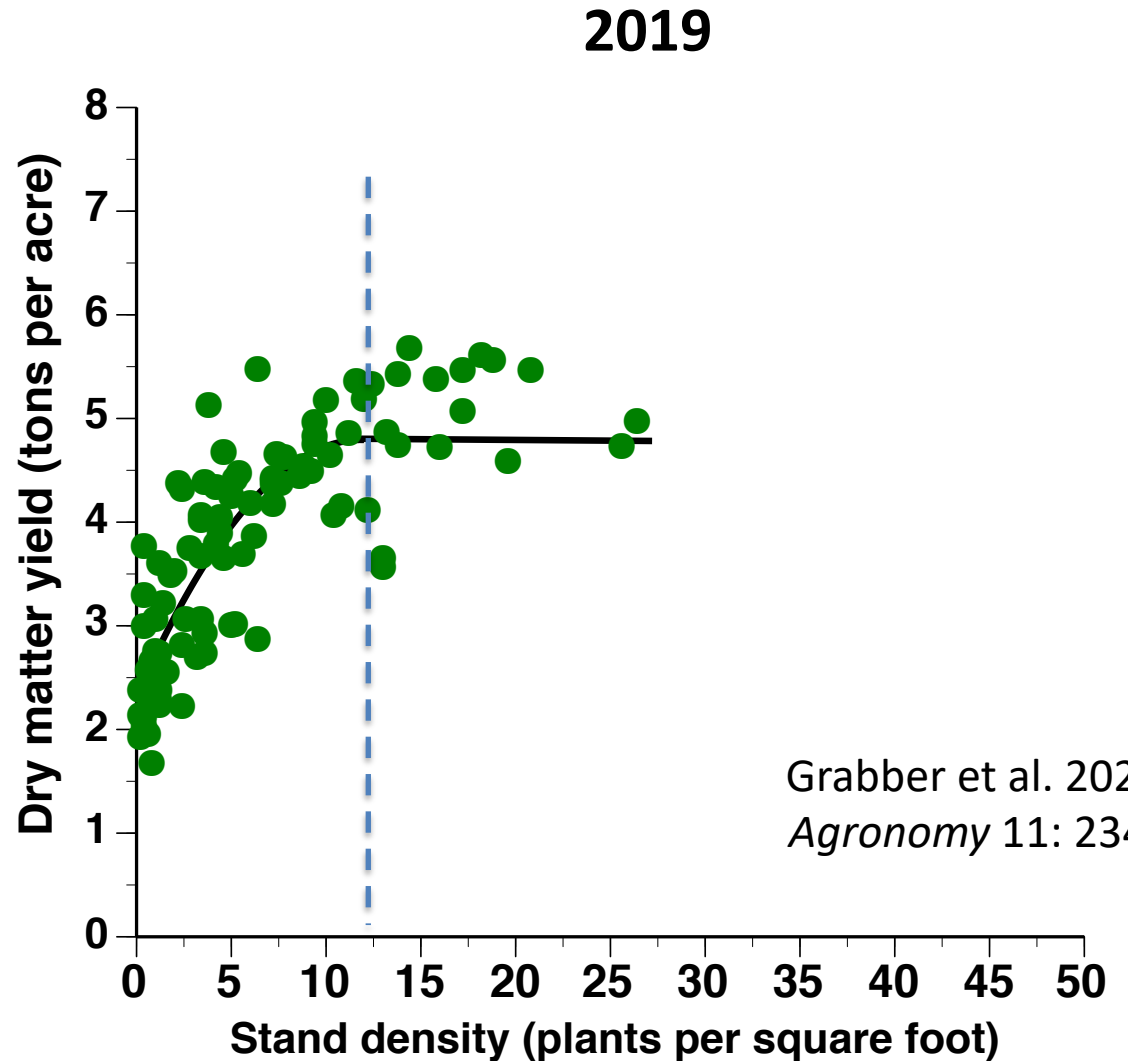
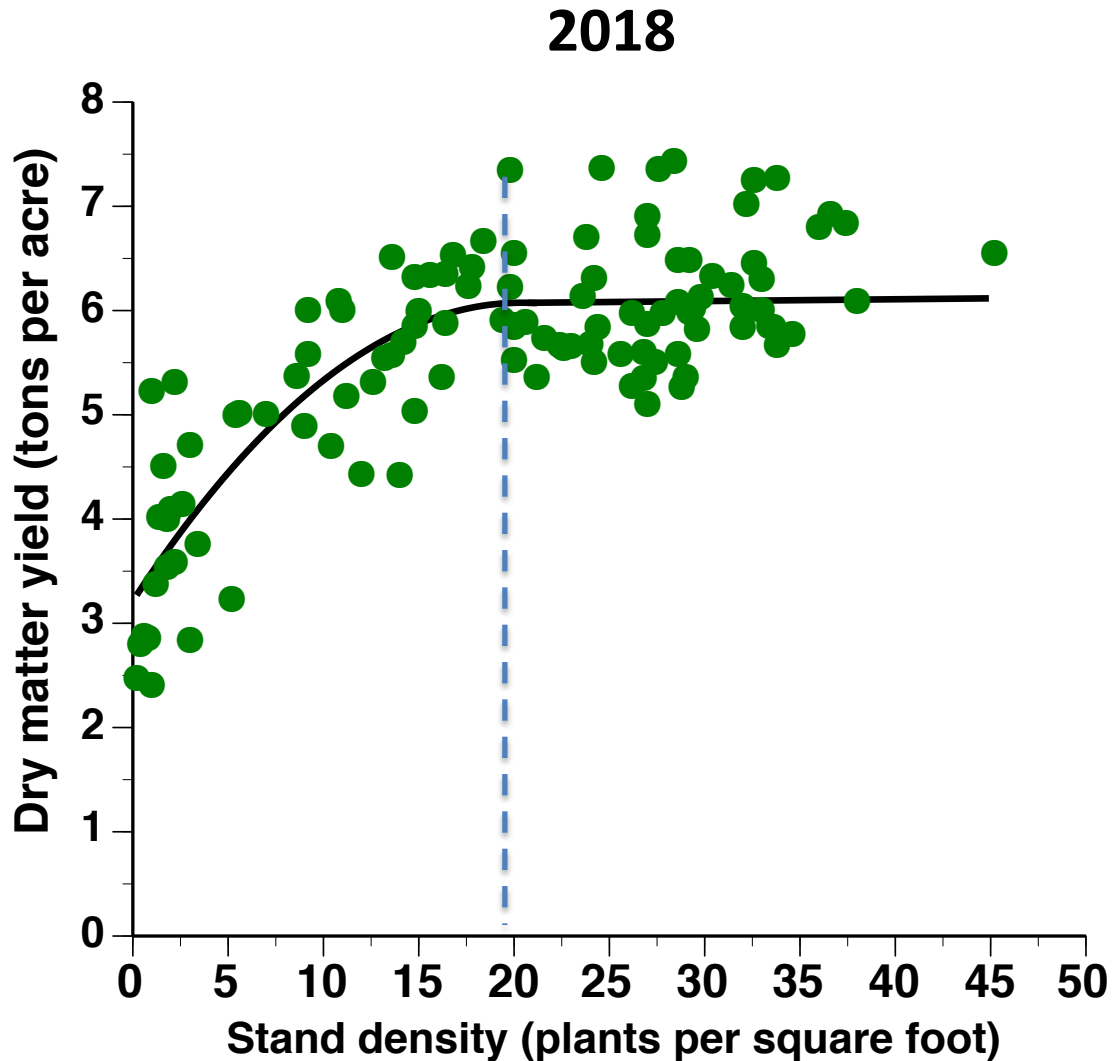
Benefits of successful intercropping

- Typically doubles 1st year alfalfa yield with modest reductions in corn silage yield
- Expected to increase net return of alfalfa - corn silage rotations by about 12%
- Reduces losses of soil, phosphorus, and nitrogen by up to 80% during and after corn production



Alfalfa establishment goal: Want 12 to 20 plants per square foot after corn silage harvest to maximize 1st year 4-cut yields of alfalfa

(Data from Prairie du Sac, Wisconsin)



Grabber et al. 2021.
Agronomy 11: 2343

**Keys to successful
alfalfa establishment
and intercropping with
corn silage**

- **Fields must be smooth, firm, and have soil pH, drainage, water availability, and fertility suitable for alfalfa and corn silage production**
- **Drill a suitable alfalfa variety at 16 lb of live seed per acre after corn planting but no later than the corn VE growth stage**
- **Plant a short-season corn hybrid with good agronomic traits at moderate populations (25 to 30K per acre) in a 30-inch row spacing with full rates of nitrogen fertilizer**

Interseed alfalfa at or before the VE stage into a properly fertilized & prepared seedbed



Moderate corn populations allow light penetration to alfalfa



- For weed control in conventional alfalfa and corn, use encapsulated acetochlor, bromoxynil, and pendimethalin (control of annual grasses can be a problem)
- Encapsulated acetochlor and glyphosate provide excellent weed control for Roundup-Ready corn and alfalfa
- Apply prohexadione on 4- to 12-inch alfalfa in June and/or fungicide and insecticide when corn is 4-6 ft tall to aid alfalfa establishment
- Harvest corn silage during the last week of August or first week of September to allow alfalfa recovery before winter
- Fertilize alfalfa to support high yield and persistence

Prohexadione application



Fungicide and insecticide application



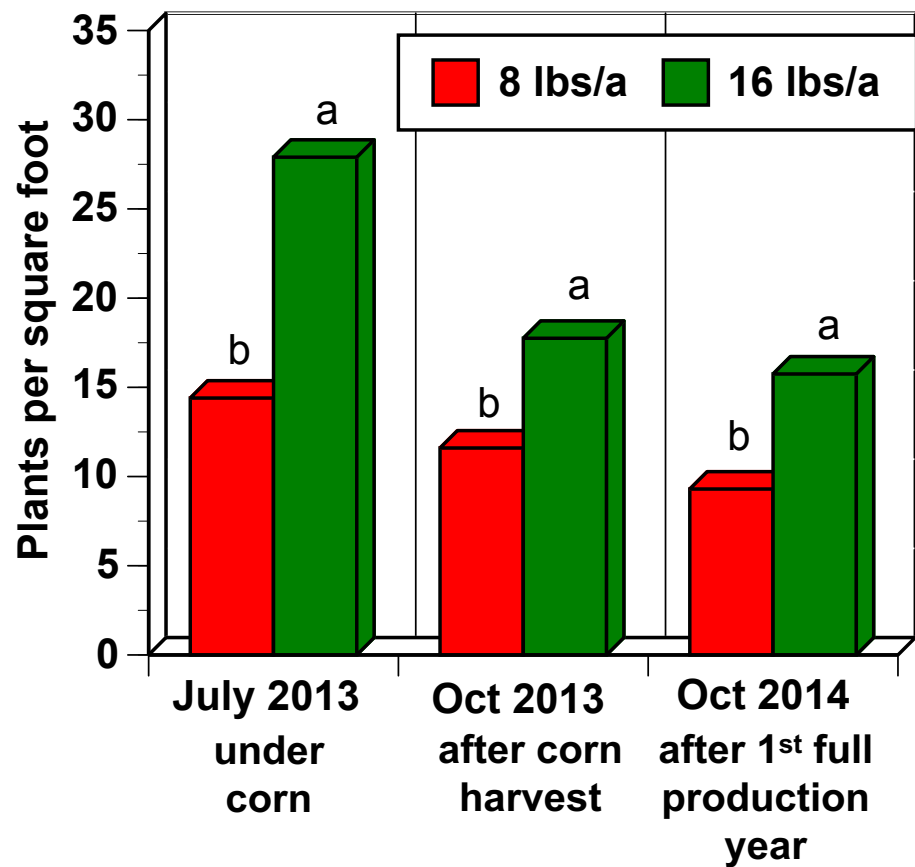
Alfalfa recovery in fall following early corn harvest and fertilization



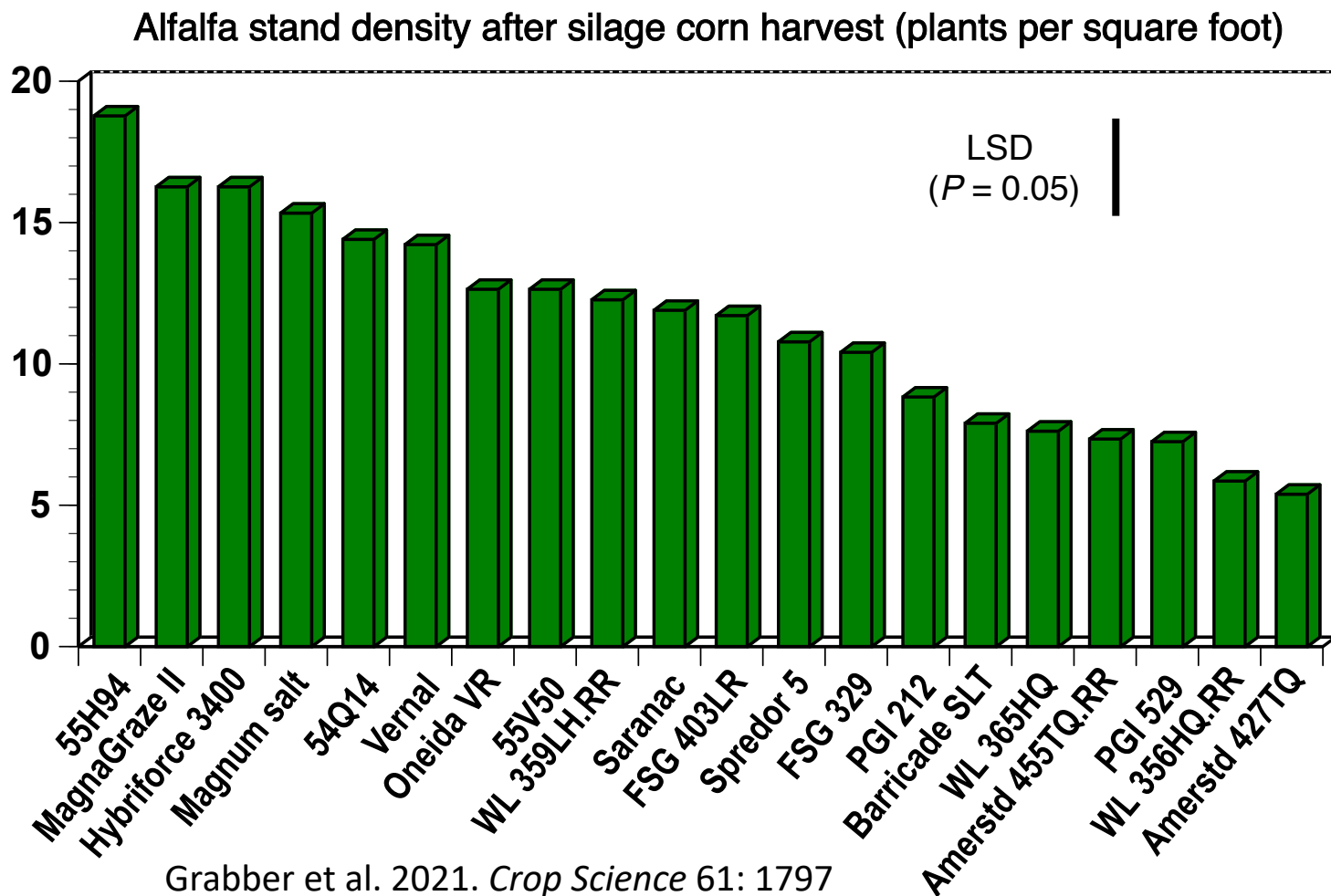
Key research findings and observations



Use normal alfalfa seeding rates and varieties that are well-adapted for interseeding into corn



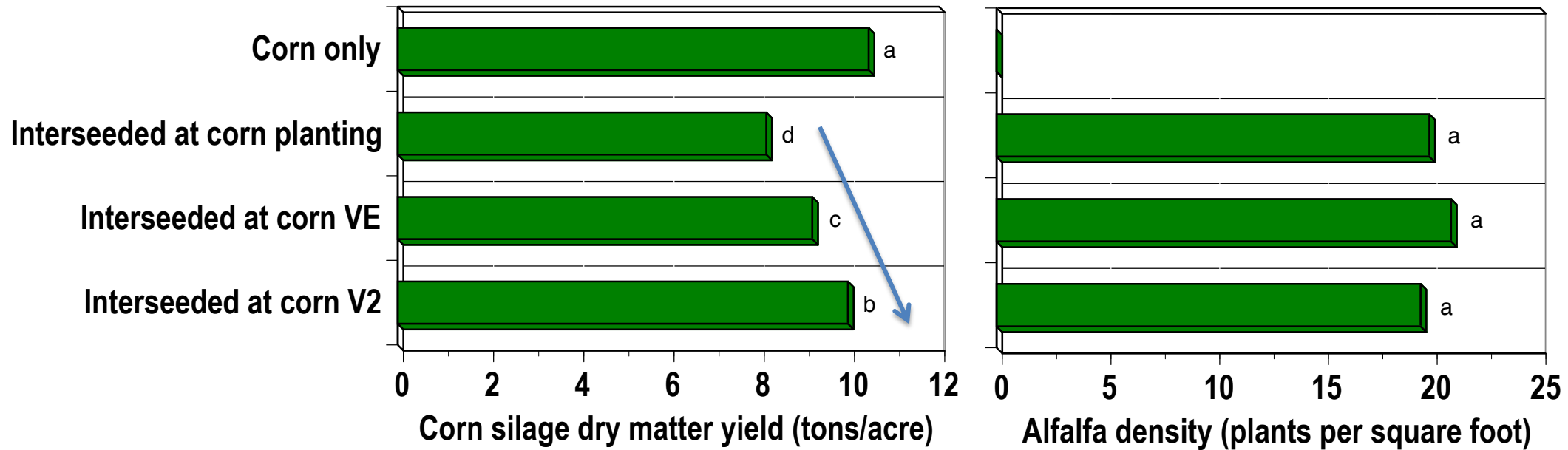
Means with unlike letters differ at $P = 0.05$
 Grabber. 2016. *Agronomy Journal* 108: 726



Grabber et al. 2021. *Crop Science* 61: 1797

Under favorable conditions, interseeding can be delayed until corn stage V2 to improve corn silage yield without impacting alfalfa plant survival

Results from Prairie du Sac, Wisconsin averaged across 2020 and 2021



Interseeded at corn planting



Interseeded at corn VE



Interseeded at corn V2



Photos taken October 2020

**If conditions are wet and corn yields are high,
delaying interseeding until corn stage V2 will
reduce alfalfa vigor and plant survival**

Photos taken October 2022, ongoing work at Prairie du Sac, Wisconsin

Interseeded at corn planting



Interseeded at corn VE



Interseeded at corn V2



Agrichemical treatments enhance alfalfa plant survival in humid environments when corn silage yields are high

July

August

October

Non-treated control

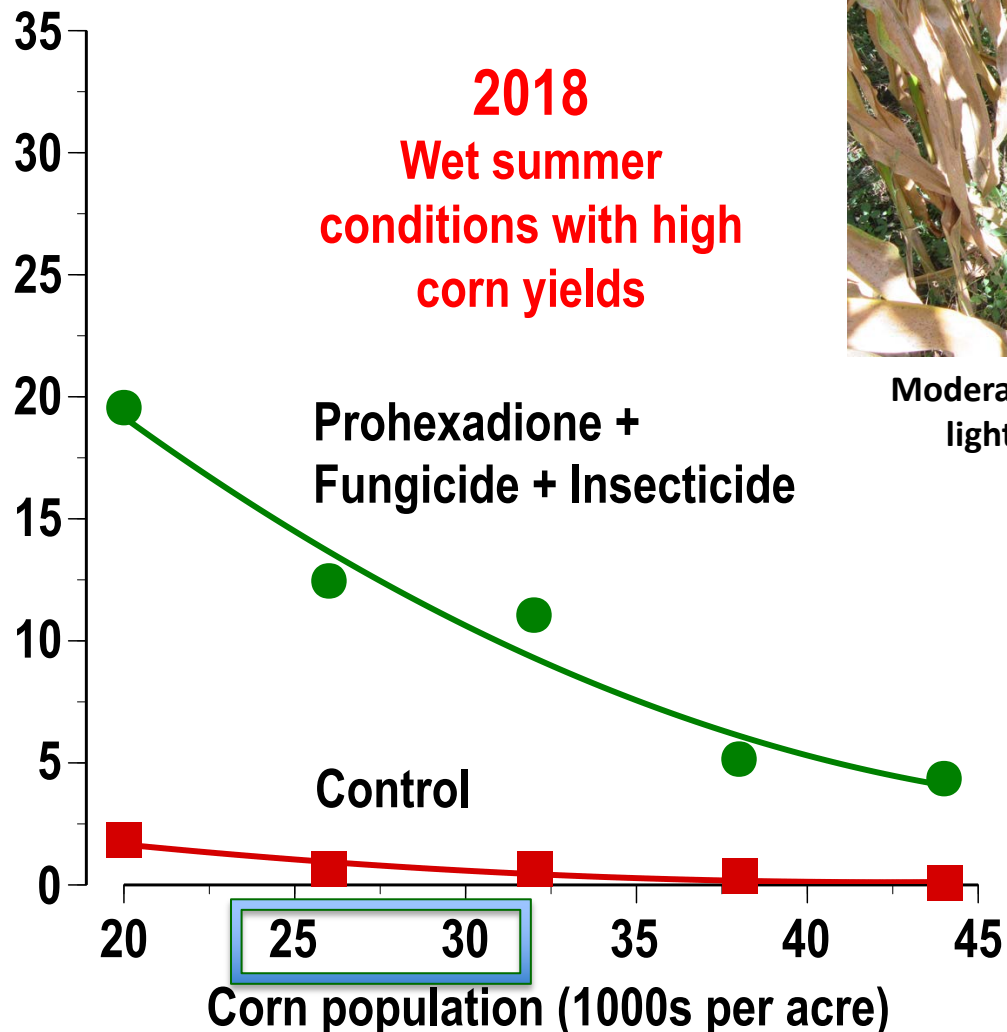
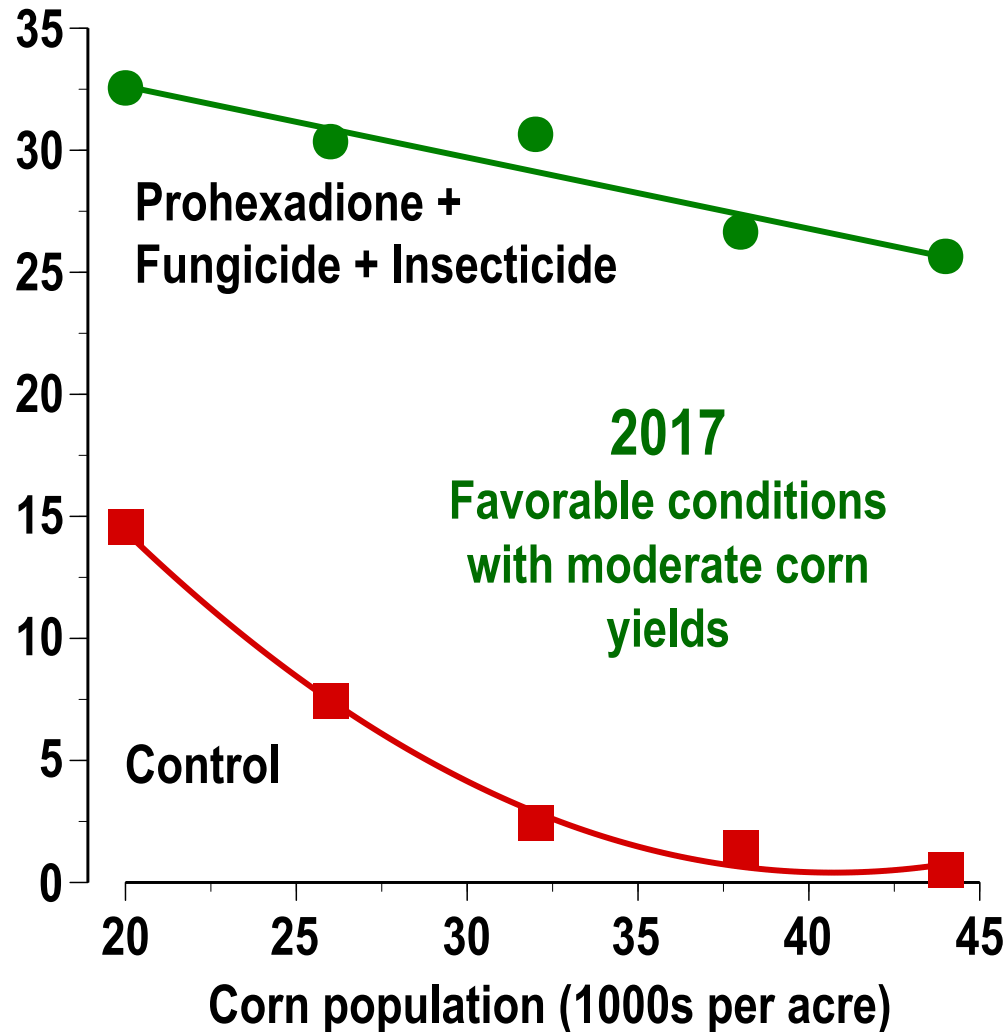


Prohexadione
+ Fungicide +
Insecticide



Use moderate corn populations to aid alfalfa establishment

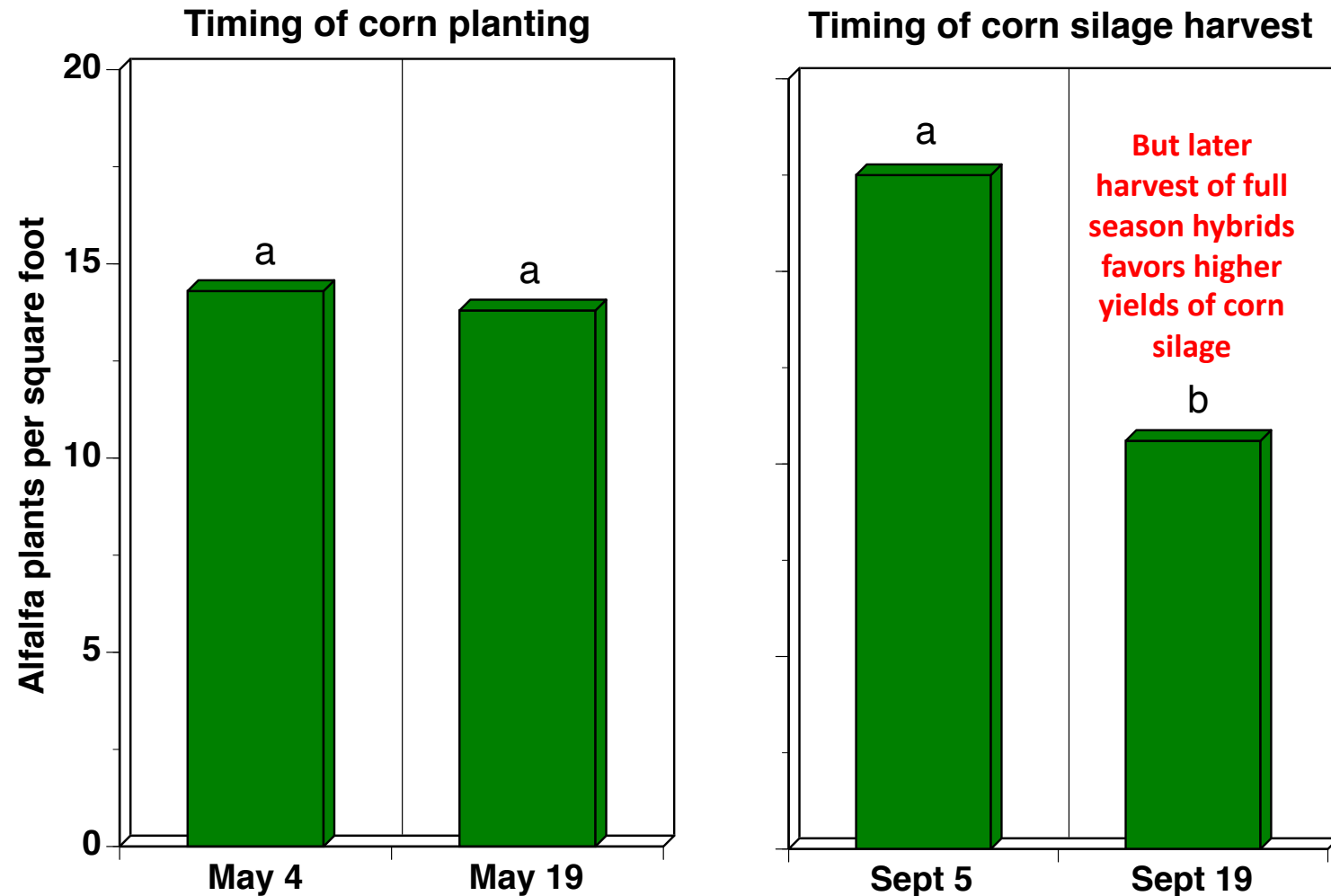
Alfalfa plants per sq ft after corn harvest



Moderate corn populations allow light penetration to alfalfa

Establishment of alfalfa generally not influenced by corn planting time, but favored by early corn harvest

Under continuing study



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

Treatments with unlike letters differ at $P = 0.05$



**Don't interseed
during a spring
drought**



**Avoid harvesting corn if soils
are wet and easily rutted**

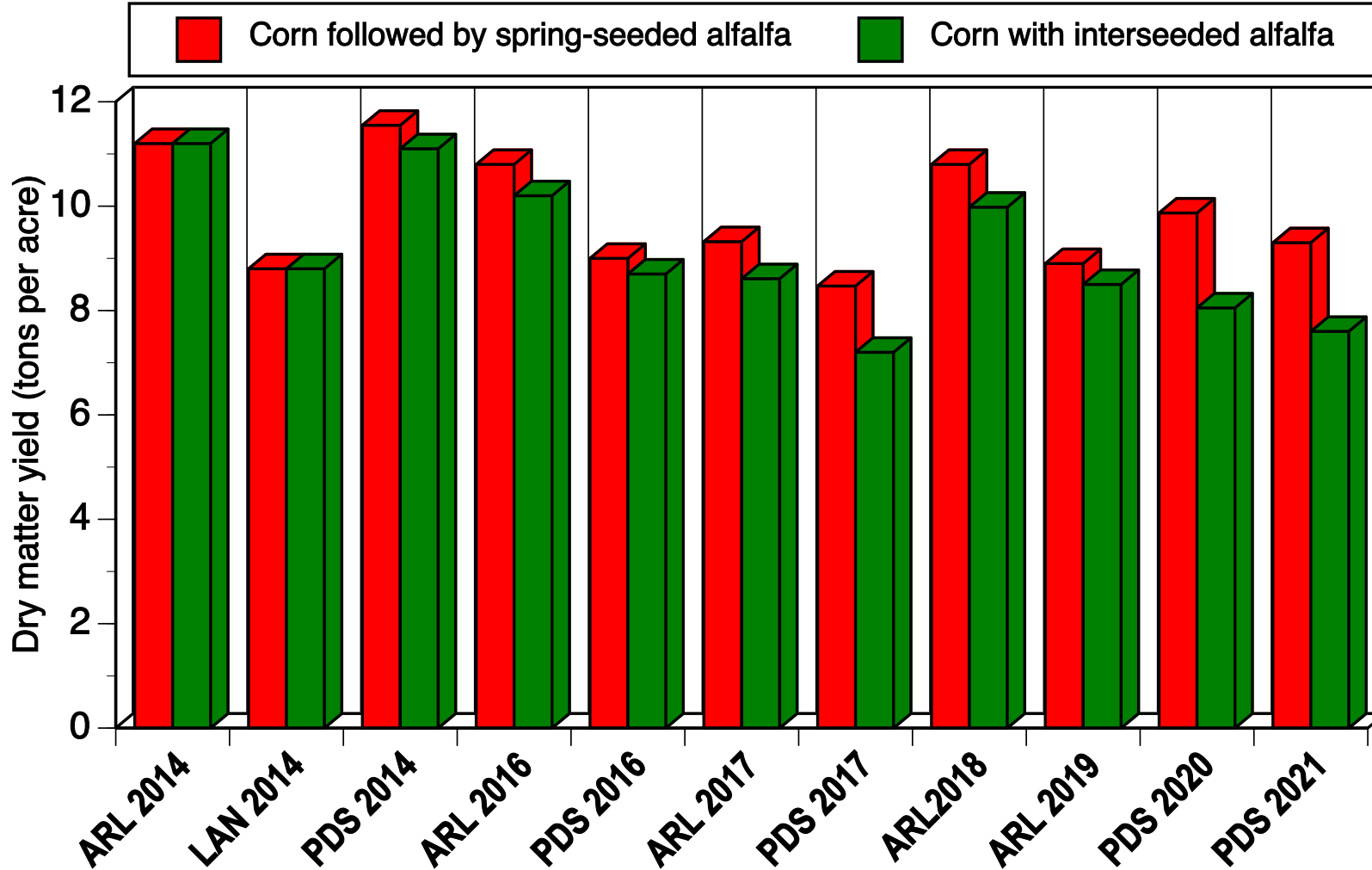


Stand recovery by mid October

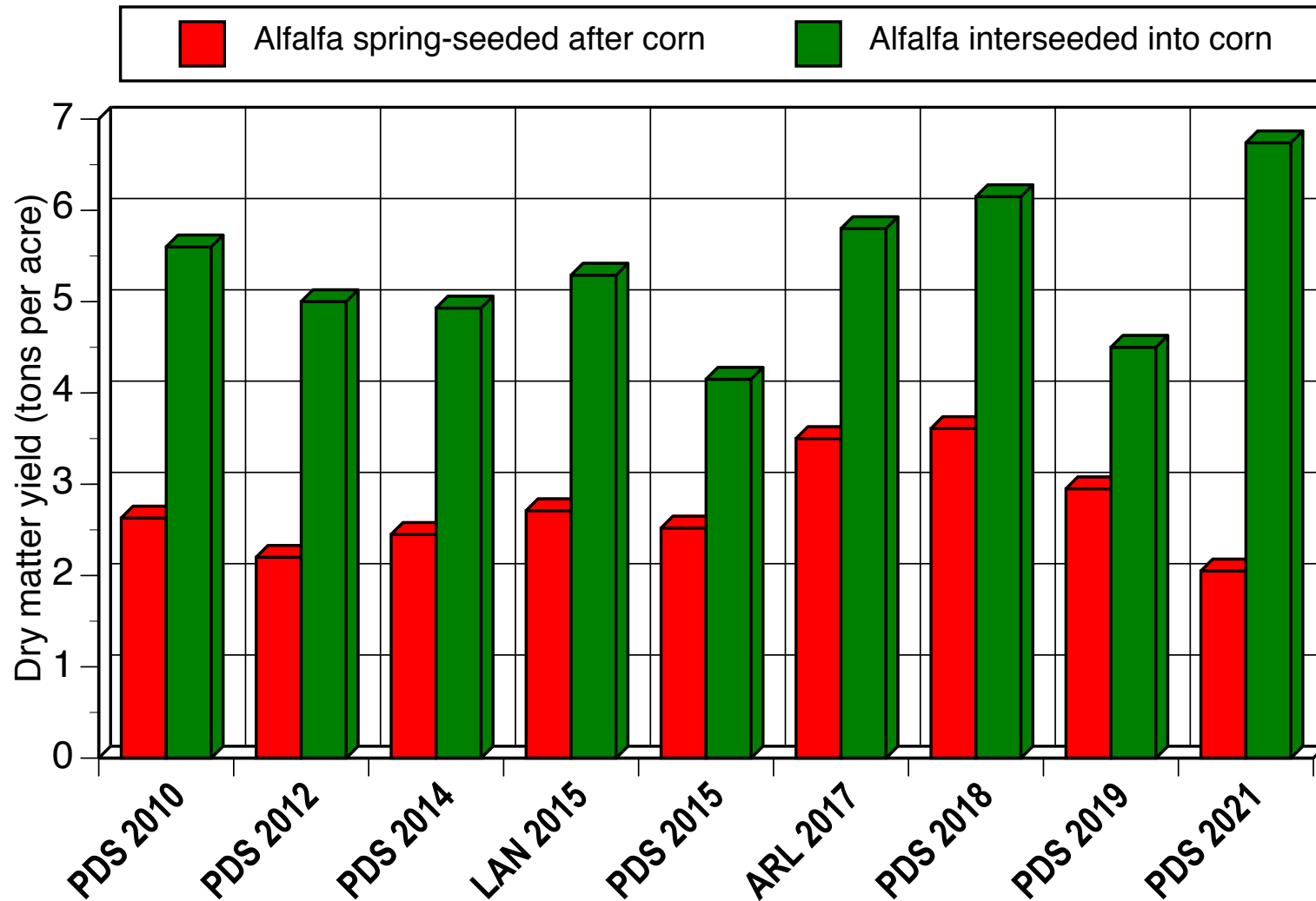
Farm near Brillion, WI. Photos by Brad Holtz, 2018

Alfalfa interseeding immediately after corn planting reduces corn silage yield by about 7.5% if adequate nitrogen is applied

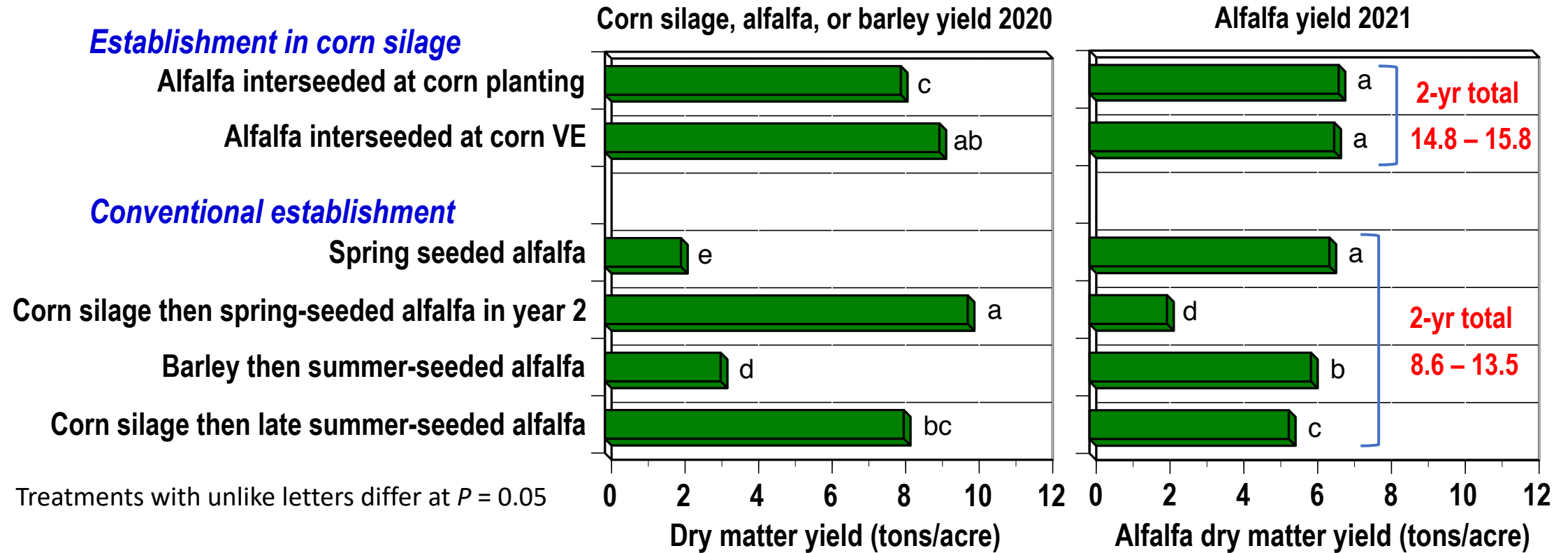
Nitrogen fertilizer applied at 190 to 200 lbs per acre



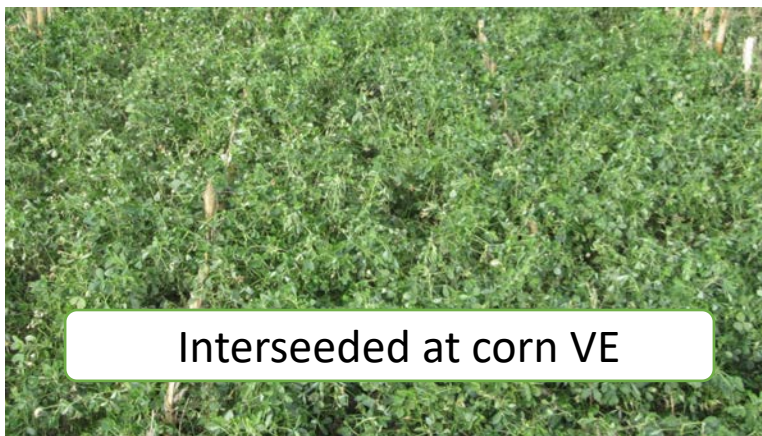
Following successful establishment in corn, first year yields of interseeded alfalfa are 1.6 to 3.3-fold greater than spring seeded alfalfa



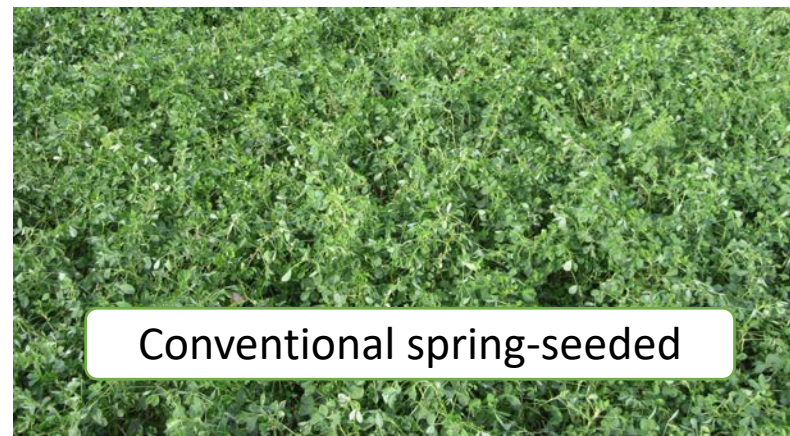
Alfalfa establishment in corn verses conventional systems: Yields in Wisconsin



Photos of alfalfa stands in autumn after establishment

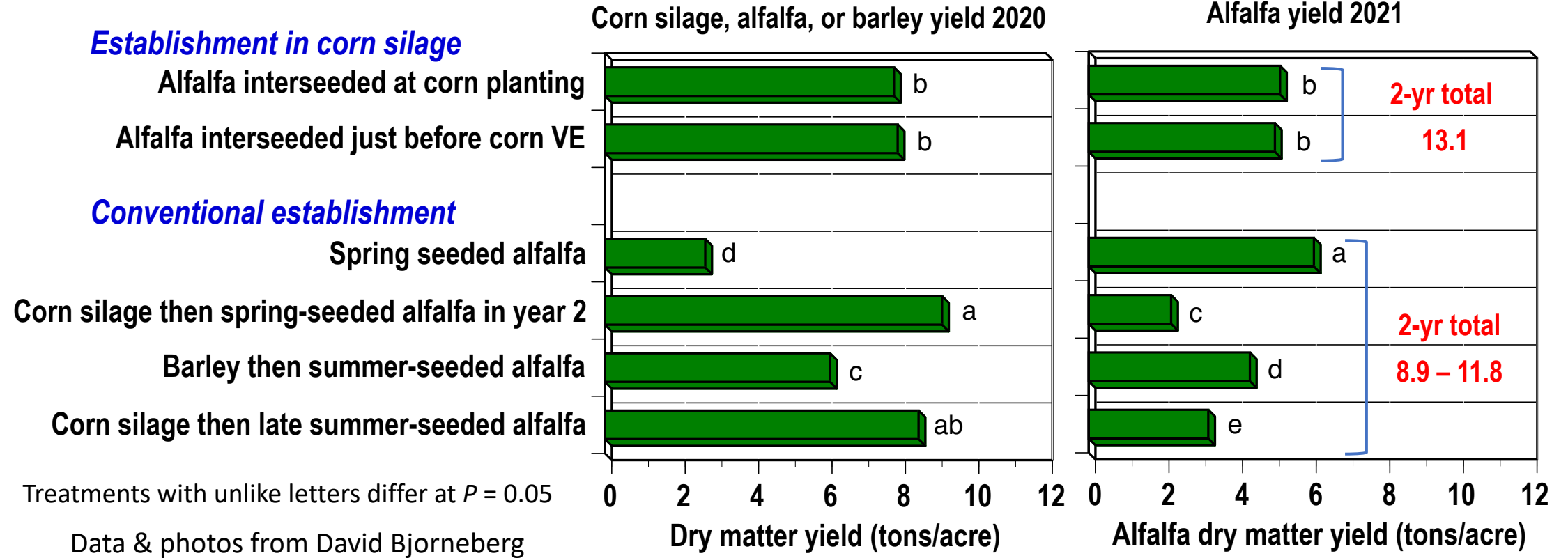


Interseeded at corn VE



Conventional spring-seeded

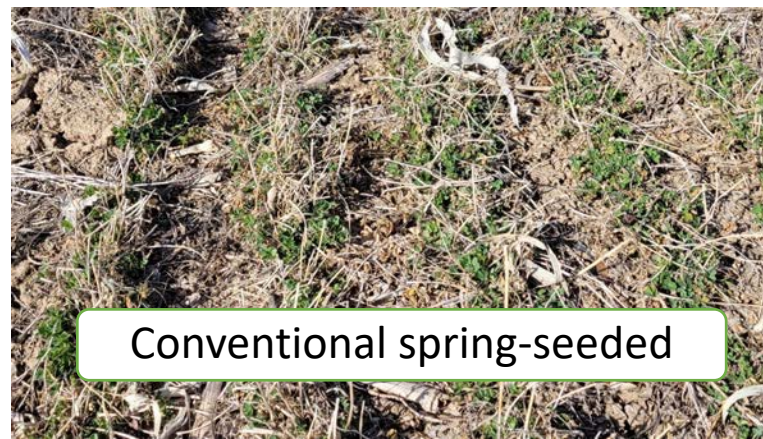
Alfalfa establishment in corn verses conventional systems: Yields in Idaho



Photos of alfalfa stands in late winter after establishment



Interseeded before corn VE



Conventional spring-seeded

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**

Estimated input costs and value of feed produced for a dairy farm in southern Wisconsin

Key assumptions:

- Interseeded alfalfa increases corn nitrogen requirements from 160 to 200 lbs per acre
- Interseeded alfalfa reduces corn silage yield by 5%, but doubles 1st year alfalfa yield
- Alfalfa feed value 1.3-fold greater than corn silage
- \$48 per acre cost for applying agrichemicals to interseeded alfalfa
- 80% success rate for alfalfa establishment by interseeding; failed stands reseeded the following spring

Osterholz et al. 2020.
Agronomy Journal 112:4120

Interseeding alfalfa into corn reduces losses of soil and nutrients from cropland

Reductions in runoff due to interseeding alfalfa in corn

Timing of runoff study	Soil	N	P
Early June during corn production	45%	23%	36%
October after silage corn harvest	86%	72%	62%
Following April before alfalfa production	87%	75%	82%



Ongoing work to improve alfalfa-corn silage intercropping

- **Developing improved alfalfa varieties for intercropping**
- **Identifying hybrid traits needed to maximize corn yield**
- **Refining agrichemical applications on interseeded alfalfa**
- **Improving fertilizer, manure, planting, and harvest management for corn and interseeded alfalfa**
- **Examining long-term persistence and yield of interseeded alfalfa**
- **Evaluating of intercropping on producer fields**

Thank you!

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Alfalfa
established under
corn silage at the
University of
Wisconsin
Arlington
Research Station

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