

Using Reduced-Lignin Alfalfa to Improve WUE, Forage Yield and Quality in Water-Limiting Environments

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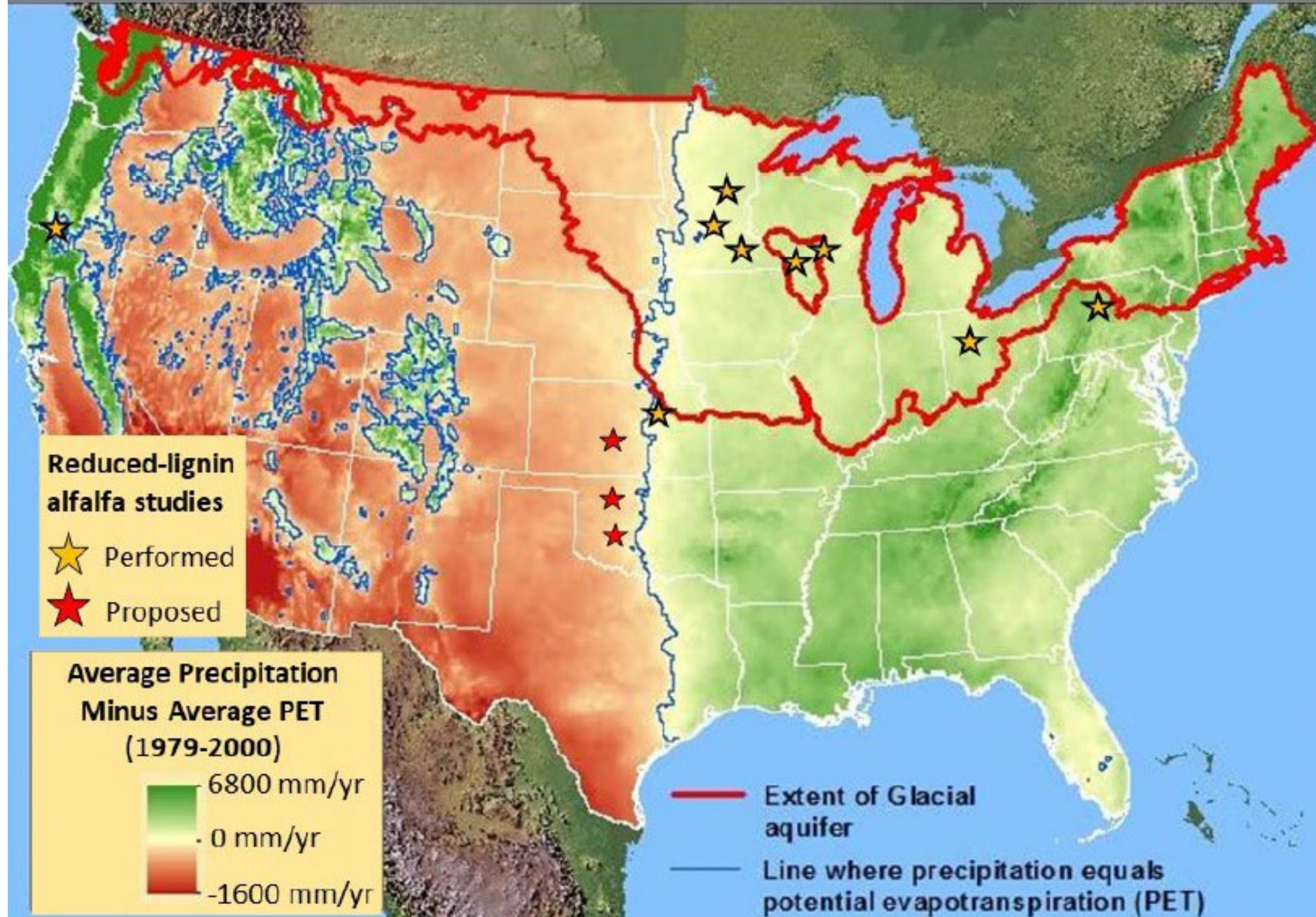
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Objective 1

- Conduct a **comprehensive survey** of current management practices and associated forage yield in commercial alfalfa fields of the CGP to benchmark alfalfa water use-efficiency and characterize the **management practices associated with potential yield** in the region;

WUE benchmark – Objective 1

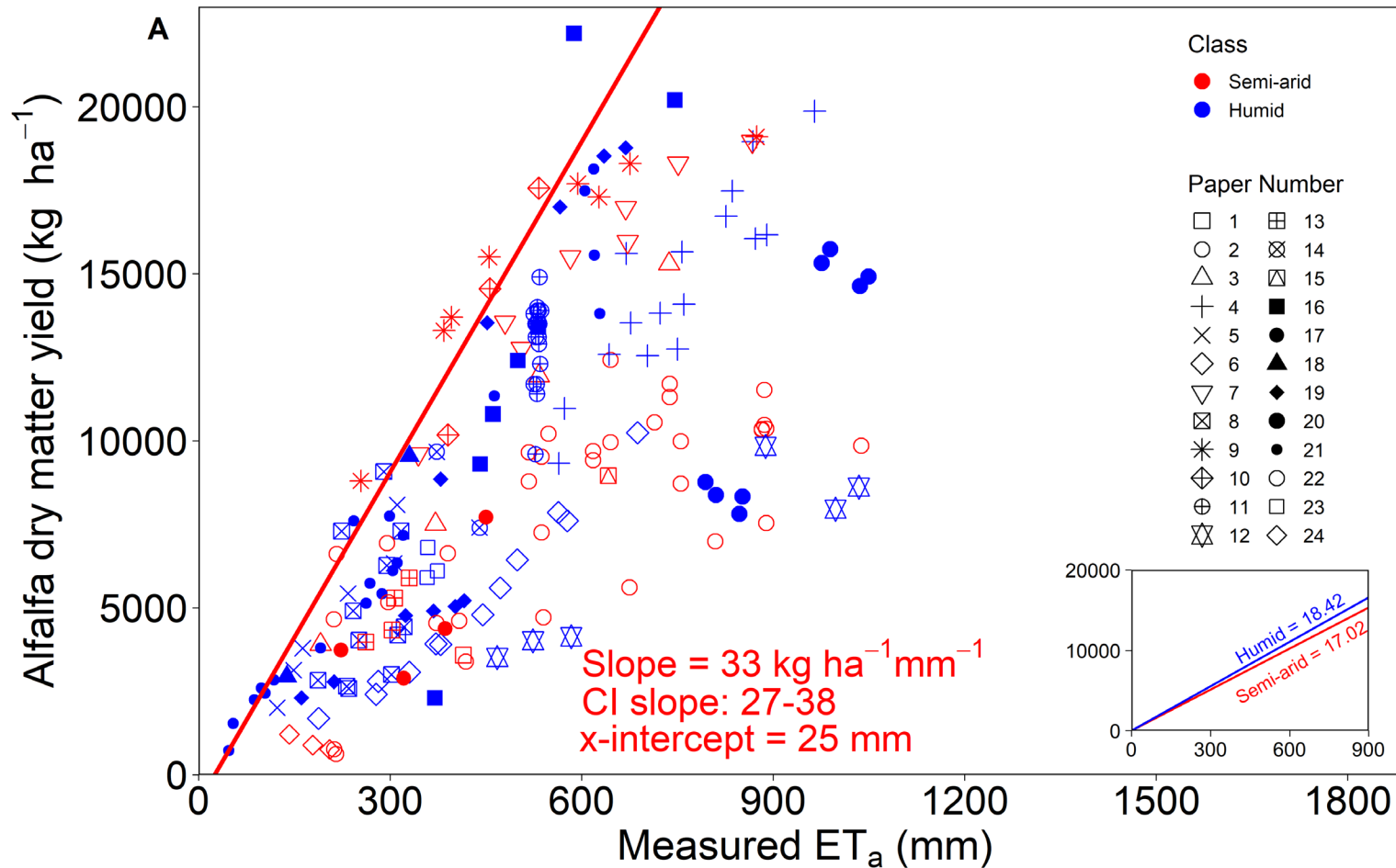


Fig. 3. Relationship between literature-reported alfalfa yield and ET_a in semi-arid ($n = 70$, red markers) and humid climates ($n = 173$, blue markers). The red solid line represents the boundary function using the 95th percentile. Inset shows the yield-ET_a linear regressions developed for arid (red line) and humid climates (blue line) from the database with values showing the WUE for each climate.

On-farm survey – Objective 1

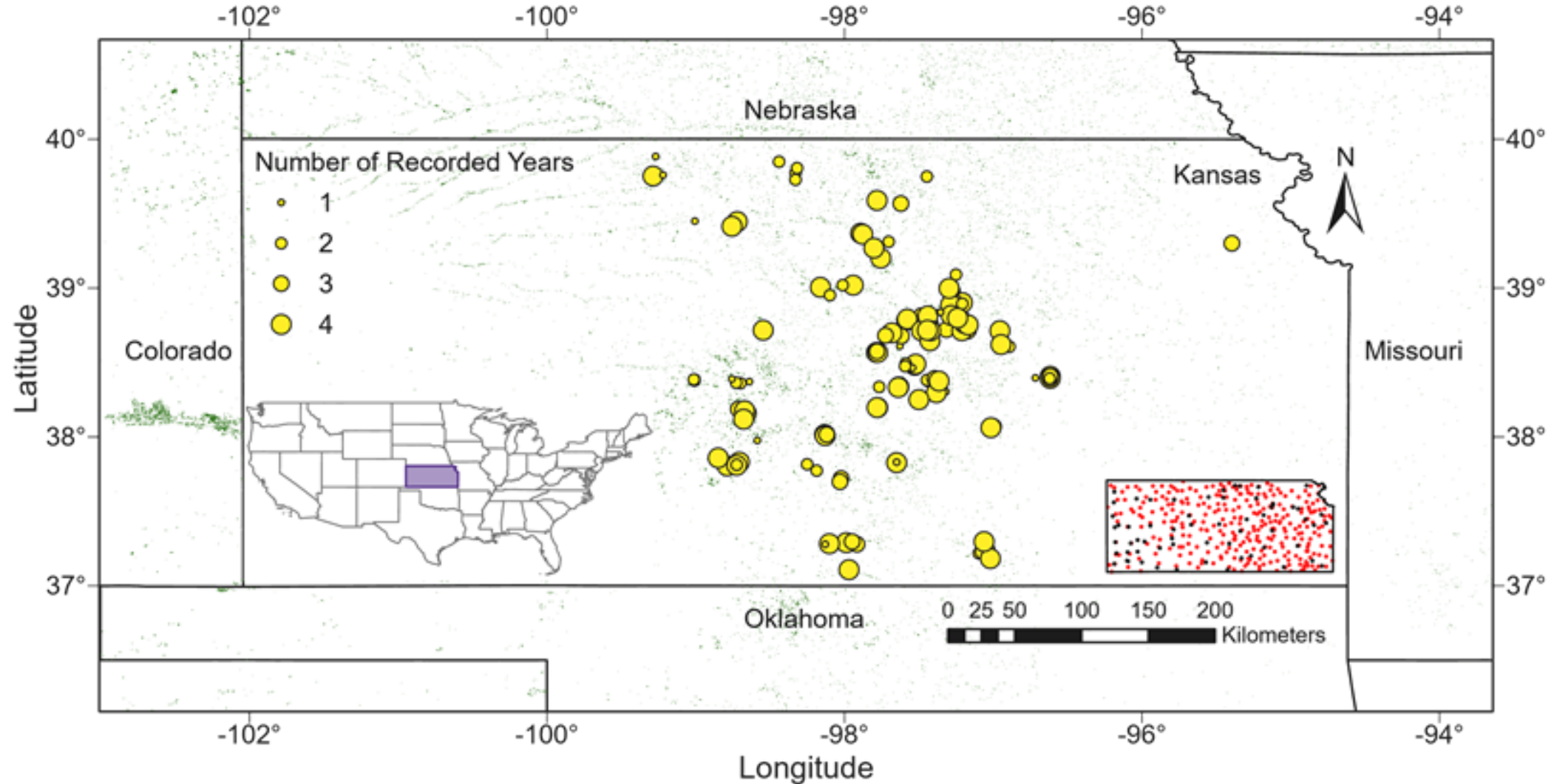


Fig. Map of Kansas (U.S.) showing alfalfa planted area (green) and location of surveyed fields in 2016, 2017, 2018, and 2019 (yellow markers). Size of marker represents the number of years of data provided in the survey for each field.

On-farm survey

– Objective 1

Table: Frequency of field-years following management practices as determined via surveys collected from alfalfa fields across central Kansas.

Management	Frequency (%)
Grazing	10
Cultivar (Roundup Ready)	34
Cultivar (reduced lignin)	2
Planting Season (Fall)	81
Seed Treatment	84
Seed Inoculated	92
(Conventional tillage)	78
In-furrow Fertilizer	17
Lime	42
Companion Crop	3
Phosphorus	78
Potassium	40
Sulfur	32
Micronutrients	24
Fungicide	1
Insecticide	88
Herbicide	66
Cuttings Per Year (1, 2, 3, 4, 5)	2, 7, 13, 53, 25

On-farm survey – Objective 1

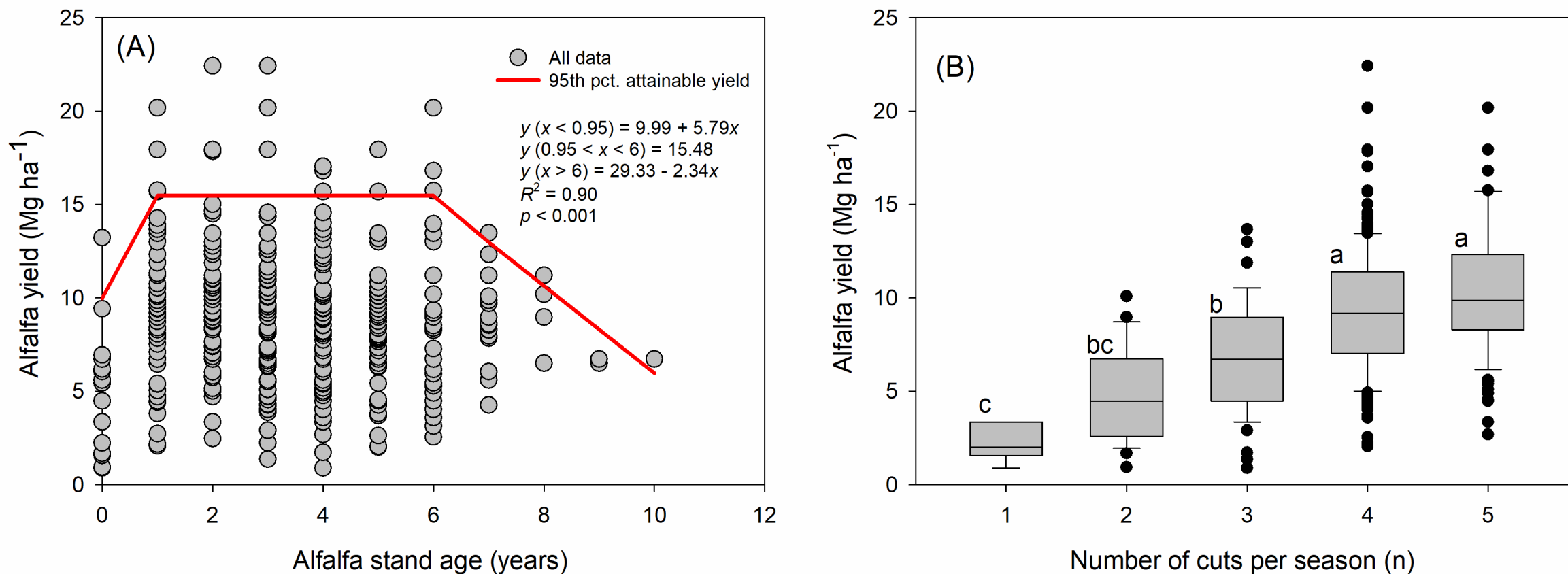


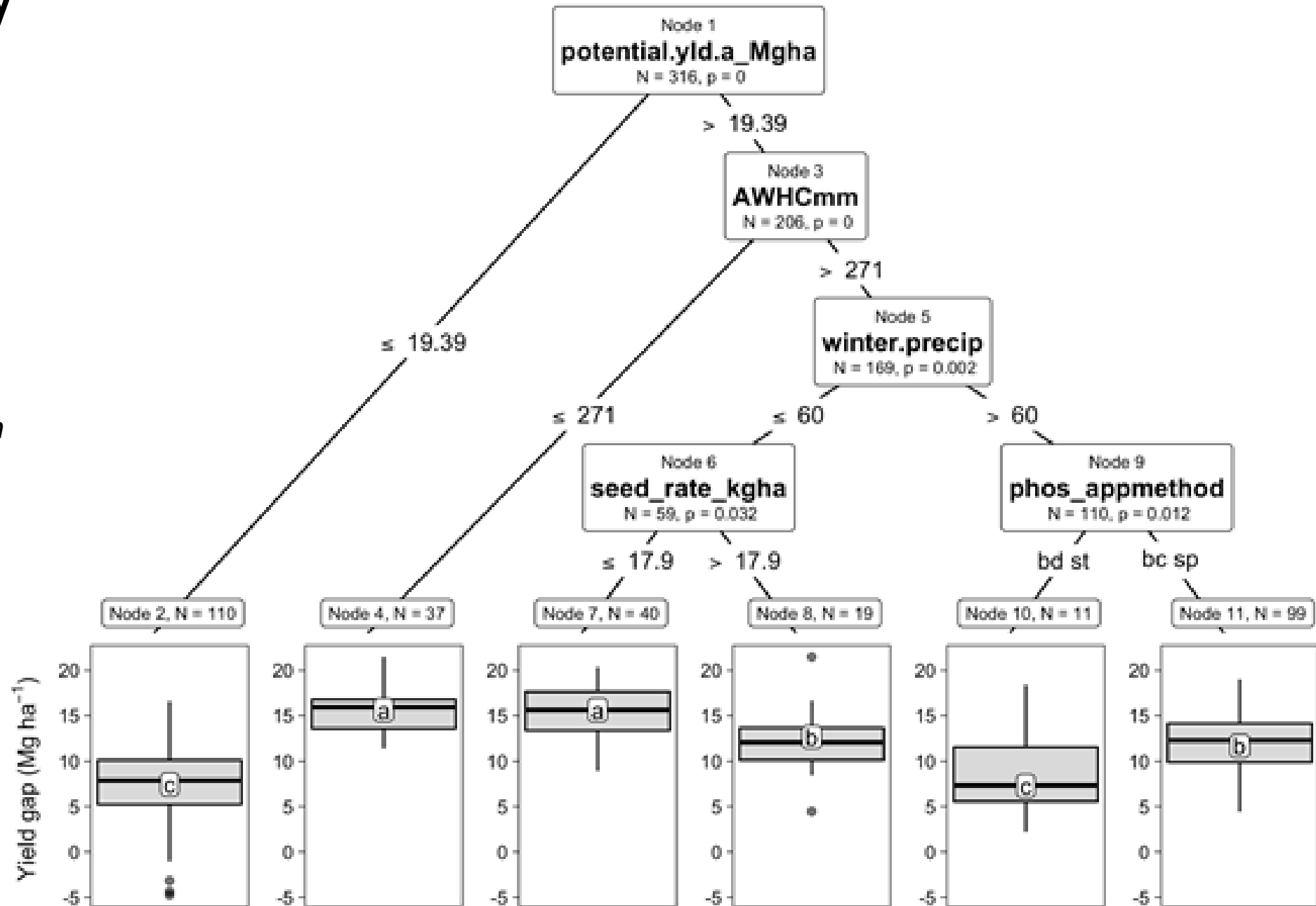
Fig. (A) Attainable alfalfa yield as affected by stand age (years). Red line denotes the 0.95 percentile regression. Year equal to zero denotes sowing-year yield of spring-sown fields. (B) Distribution of alfalfa yield as function of number of cuts per season. Box-plots followed by a common letter are not significantly different by the Tukey test at the 5% probability level.

On-farm survey – Objective 1

Fig. Conditional inference tree of the effects of weather, soil, and management practices on alfalfa yield Y_g across 394 field-years surveyed.

Acronyms:

- *AWHCmm*, Available water holding capacity in the 180 cm soil profile (mm);
- *phos_appmethod*; phosphorus application method (*bd* = banded, *st* = streamed, *sp* = sprayed, *bc* = broadcast);
- *potential.yld.a_Mg ha*, water limited yield; *seed_rate_kgha*, seeding rate (kg ha^{-1});
- *winter.precip*, cumulative rainfall during the winter (mm).



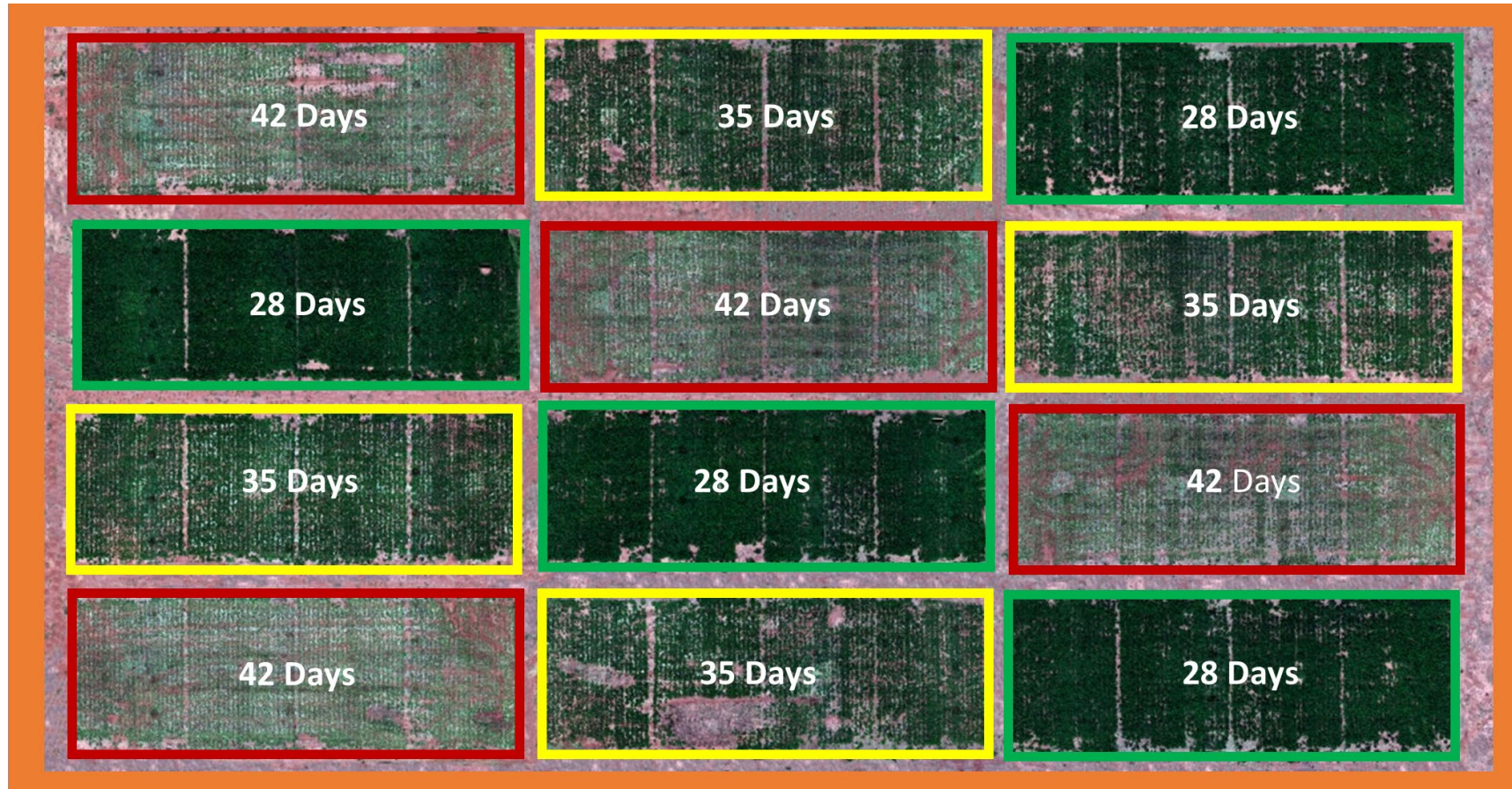
Objective 2

- Quantify the effects of **cutting management** of **conventional and reduced-lignin alfalfa cultivars** on forage yield, forage quality, and water-use efficiency in a dry subhumid environment;

Reduced lignin field trials – Objective 2

Experimental Design

MAIN PLOTS



Aerial view of the alfalfa research plot. Image was provided by Dr. Yuting Zhou, Dept. of Geography, OSU.

Reduced lignin field trials – Objective 2

Experimental Design

MAIN PLOTS



Alfalfa Cultivars	Cultivar Traits
54HVX41 (HVX)	Reduced Lignin, Roundup Ready
54VR10 (VR)	Roundup Ready
DKA44-16RR (DKA)	Roundup Ready
WL 356 HQ.RR (WL)	Roundup Ready

Aerial view of the alfalfa research plot. Image was provided by Dr. Yuting Zhou, Dept. of Geography, OSU.



Objectives

3. Assess the **economic feasibility of reduced-lignin** alfalfa in water-limited environments; and
4. **Disseminate** project findings and products to stakeholders.

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