# Weed suppression in warm-season grass-legume intercrops

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## Introduction

### Background

- Increasing frequency of extreme weather events, especially in the northeastern United States[1]
- Functional diversity is better than species richness at explaining variance in productivity[2,3,4,5]
- Warm-season grass-legume intercrops can be managed as cover or forage crops and fit into a small grains double-cropping system
- Selected species are drought tolerant, fast-growing, and require fewer inputs than corn silage
- Increasing functional diversity of crops enhances resource-partitioning, making light, nutrient, and water resources less available to weeds[6]

Field of warm-season annual crops planted in Aurora, NY mid-June in 2014.

### Objectives

- Compare crop and weed biomass production in warm-season annual crops.
- Measure how functional diversity affects weed suppression.
- Evaluate results at different in locations that vary in environmental conditions.

### Hypothesis

**Crop biomass and weed suppression would be greater in grass-legume intercrops compared to the same crops grown in monocultures.**

## Materials and Methods

We tested 4 warm-season annual species in 6 site-years in 2013 and 2014 (Table 1).

### Field Management

- Fields were plowed, disked, cultipacked, and fertilized with 35 kg ha$^{-1}$ of N in the form of poultry litter (except in the 13 Aur-L site-year where urea was used)
- Crops were drilled to a 1'' depth

Table 1. Planting and sampling dates for years and field sites. Site-ID names relate to whether the crop was planted before (E for early) or after (L for late) a winter small grain crop would be harvested.

| Location | Year | Site-ID | Replicates | Planting date |
|---|---|---|---|---|
| Aurora, NY | 2013 | 13 Aur-L | 5 | 15-July |
| | 2014 | 14 Aur-E | 4 | 20-June |
| | 2014 | 14 Aur-L | 4 | 10-July |
| Beltsville, MD | 2014 | 14 Bel-L | 4 | 23-July |
| Willsboro, NY | 2014 | 14 Wil-E | 6 | 17-June |
| | 2014 | 14 Wil-L | 6 | 15-July |

**Pearl Millet (M)** — Grass

*Pennisetum glaucum* (L.) R. Br

**Sorghum Sudangrass (S)** — Grass

*Sorghum bicolor* (L.) Moench × *S. sudanense* (Piper) Stapf

**Cowpea (C)** — Legume

*Vigna unguiculata* (L.) Walp

**Sunn Hemp (H)** — Legume

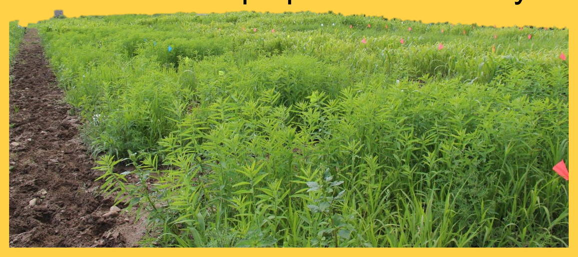
*Crotalaria juncea* L.

### Seeding Rates

The four species were each planted in monoculture at the recommended seeding rate and in 3 and 4 species mixtures using a replacement design (Table 2).

Table 2. Target crop seeding rates used in the four monocultures and five mixtures.

| Treatment | Pearl millet (M) | | S. sudangrass (S) | | Cowpea (C) | | Sunn hemp (H) | |
|---|---|---|---|---|---|---|---|---|
| | g seed m$^{-2}$ (seeds m$^{-2}$) | | | | | | | |
| M | 2.1 | (60) | — | | — | | — | |
| S | — | | 6.6 | (46) | — | | — | |
| C | — | | — | | 7.0 | (15) | — | |
| H | — | | — | | — | | 5.6 | (30) |
| MSC | Each species seeded at **one third** of its monoculture rate | | | | | | | |
| MSH | | | | | | | | |
| MCH | | | | | | | | |
| SCH | | | | | | | | |
| MSCH | Species seeded at **one fourth** of monoculture rate | | | | | | | |



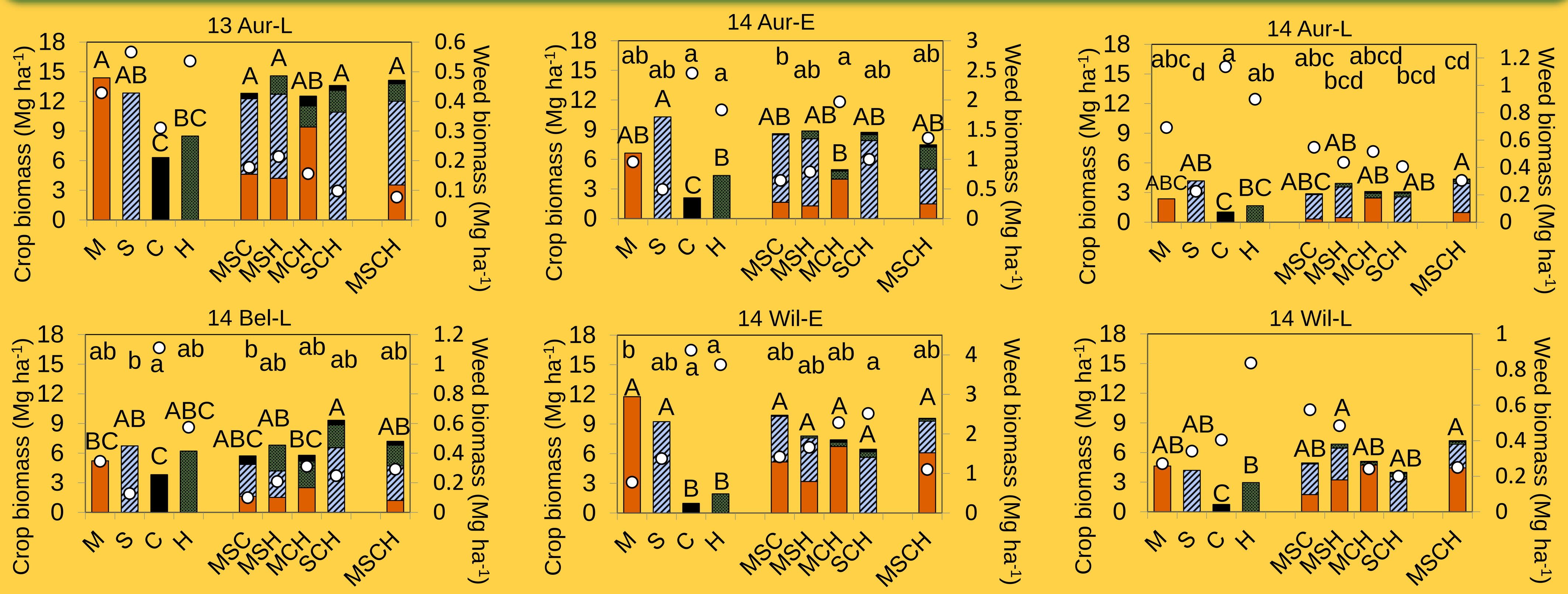
Clockwise: no-till drill seed box, pearl millet seedlings, warm-season intercrops in Willsboro, heading sorghum sudangrass, and annual crops planted mid-July.

### Sampling and Statistics

- Crop and weed biomass were sampled halfway through and at the end of the growing season (~45 and 90 days after planting) using 0.5 m$^2$ quadrats
- Each site-year was analyzed separately with seed treatment as a fixed effect and block as a random effect for an ANOVA. Tukey HSD was used to assess differences at α = 0.05
- Linear regression was used to test for the effect of species richness on weed biomass

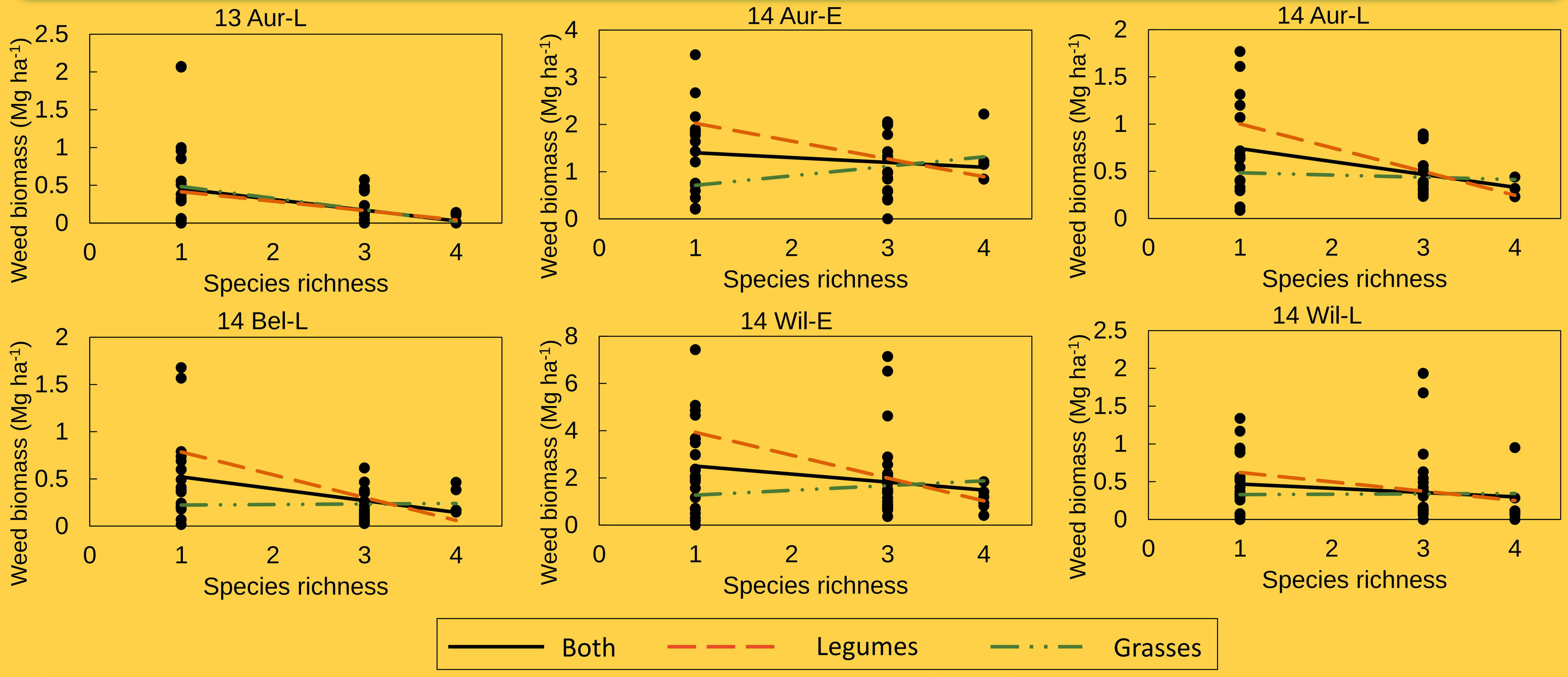
Left to right: Weeds in the cowpea monoculture in Aurora, NY. Organic dairy cows graze on summer annual forages in central Vermont. Photos courtesy of Ann Bybee-Finley and University of Vermont Extension Northwest Crops and Soils Program, respectively.

## Crop and Weed Biomass




Same uppercase letters above bars indicate no significant differences in total crop biomass and same lowercase letters at the top of the bar chart indicate no significant differences in weed biomass at $P > 0.05$ within a site. Absence of letters indicate no significant differences between treatments. Crop biomass axes do not differ, while **weed biomass axes differ**.

## Species Richness and Functional Groups




## Conclusions

- Weed biomass decreased as crop productivity increased
- **We found partial support for our hypothesis. Intercrops had greater crop biomass and weed suppression than legume monocultures, but similar crop biomass and weed suppression as grass monocultures, likely due to resource-partitioning**
- Weed biomass decreased with increasing crop diversity; however, this effect was driven by legume monoculture treatments producing relatively high levels of weed biomass
- Future research should explore the effect of crop species richness on weed suppression within grass and legume functional groups

## References

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