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Research Brief

Feed Grain Polycultures Mitigate Weather Risk, Support Beneficial Insects, and Suppress Weeds in the Western Corn Belt

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Oats (var. Reins), yield: 2498 kg ha^{-1}

Field pea (var. Delta), yield: 1423 kg ha^{-1}

Oat-pea mix
Yield: 2247 kg ha^{-1}

Oat-pea-flax mix
Yield: 2041 kg ha^{-1}

Key Findings:

- Intercropping oat with pea improved system productivity and stability compared to monocultures, even under poor weather conditions.
- Oat-pea intercrops provided ecosystem services such as weed suppression and improving habitat for predatory arthropods.
- Oat-pea intercrops met the minimum crude protein and neutral detergent fiber requirement for lactating dairy cows and high-performing beef cattle.

Background

Ensuring sustainable food production while conserving biodiversity and ecosystem services under climate change scenarios is a challenge and there is a need for highly productive, climate-resilient, sustainable, and land-use-efficient cropping systems.

Intercropping (growing multiple crops on the same land at the same time) could improve sustainable food production by providing higher and more stable grain yield, improved land use efficiency and enhanced nutritional value compared to growing a single crop. The selection of crop species for intercropping are based on their complementarity in use of light, water, and nutrients, due to their different functional traits such as rooting abilities, canopy structures, and nutrient requirements. Intercropping systems that provide ecosystem services such as weed suppression and habitat for predatory arthropods need to be developed for the U.S. Corn Belt.

Objective

The overall goal of this work was to evaluate cereal-legume intercrops in the Western Corn Belt. We evaluated oats, field pea, and flax mixtures for their potential agronomic, climate adaptation and ecosystem services benefits across contrasting weather patterns.

Methods

The study was performed without irrigation in 2023 at the Eastern South Dakota Soil and Water Research Farm in Brookings, SD. Fields were managed as no-till with synthetic fertilizer and herbicide application, with the preceding crop being soybean in 2022.

Two planting dates of April 27 (Planting A) and June 1 (Planting B) were used to provide different growing conditions. The crops were oat (variety Reins) alone, pea (variety Delta) alone, an oat-pea polyculture, and an oat-pea-flax (variety AAC Bright) polyculture (the 3-way mix was used only for the earliest planting date). Stand count, plant biomass, weed biomass, grain yield, arthropods, and grain feed quality were measured.


Oat


Pea


Oat-pea mix

Results

Planting A was cooler and drier than Planting B. (**Figure 1**).

Yields (**Figure 2**) of monocultures varied between the two weather conditions, with 30.4% and 113% higher yields of oats and peas in Planting B (warmer and wetter) compared with Planting A (cooler and drier). Oat-pea intercrop yield was the same across weather conditions. The oat-pea mixture can be at least as efficient as monoculture in land use.

The results also suggested that the mixture's yield was more stable across weather conditions compared to

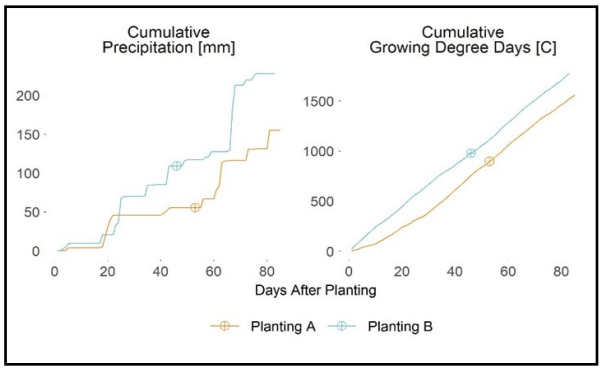

Figure 1. Weather conditions during the growing seasons.

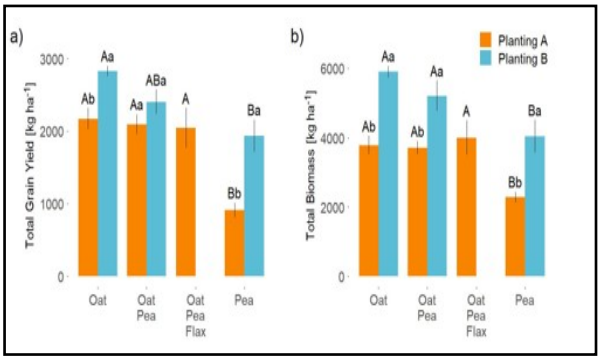

Figure 2. Weather effects on grain yield and biomass.

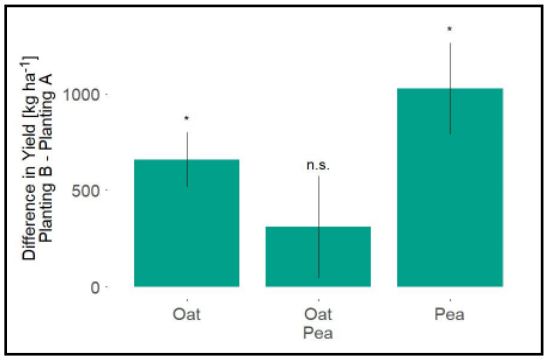

Figure 3. Stable yields of polyculture across weather.

Feed quality analysis revealed that compared to oat alone, the oat-pea mixture had higher crude protein, lower neutral detergent fiber (NDF), and similar acid detergent fiber (ADF) and total digestible nutrients. The oat-pea mixture provided well-balanced forage for lactating dairy cattle and high-performing beef cattle.

Weed biomass was low (**Figure 4**) across both weather contexts, which suggests that oat-pea polycultures were consistently able to outcompete weeds for light, water, and nutrient resources. No herbicides were used for oat or oat mixtures.

Intercropping also provided habitat for beneficial arthropods: arthropod abundance and species diversity and predation of pest insect eggs were highest in polycultures (**Figure 4**).

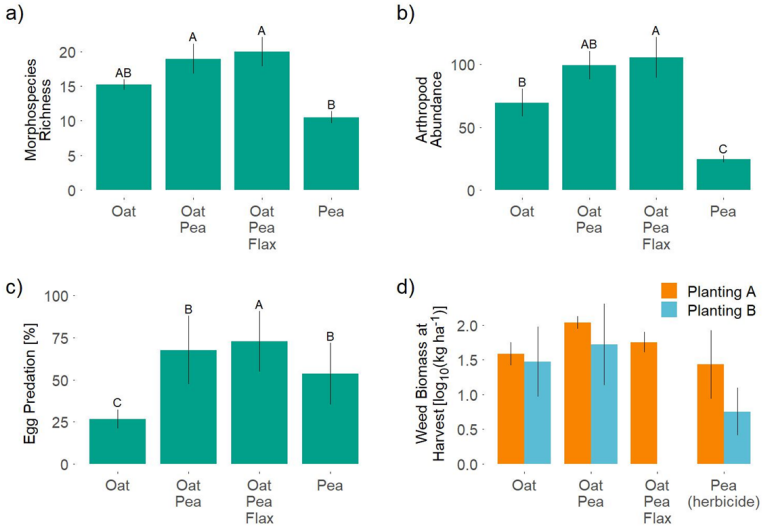

Figure 4. Polycultures enhanced beneficial arthropods and did not increase weed pressure.

Conclusions

Intercropping oat and pea improved system productivity and stability versus either crop alone, even under poor weather conditions. Oat-pea intercrops provided ecosystem services such as weed suppression and improved habitat for predatory arthropods. Oat-pea intercrops met the minimum crude protein and neutral detergent fiber requirement for lactating dairy cows and high-performing beef cattle. Further research should emphasize selection of crop varieties and relative populations to balance desired outcomes.

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Next Steps

In the future, we will conduct multi-location field trials to assess the impact of intercropping oat, pea, canola, and berseem clover on agricultural productivity, stability, feed quality, and ecosystem services such as weed suppression and habitat for arthropods. Additionally, we will investigate whether using forage legumes enhances soil nitrogen available to plants.

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About NCARL

The North Central Agricultural Research Laboratory (NCARL) is a USDA-Agricultural Research Service laboratory located in Brookings, SD. The goal of NCARL is to develop, document, and promote soil, crop, and pest management practices that are ecologically sustainable while maintaining producer profitability.

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