Incorporating native plants in insectary strips to promote insect diversity and belowground beneficial microbes in South Texas

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Consequences of intensive agriculture

- Loss of biodiversity
- Year-round weeds and pest pressure
- Soil health degradation

- Broad-spectrum chemicals to control pest target beneficial insects and pollinators
- Organic compliant chemicals and labor are expensive inputs

Source: iStock

Source: ag.umass.edu
Why biodiversity is important for soil health

**Plant-microbe interactions:**
- Plant Growth Promotion (PGP)
- Biotic and abiotic stress protection
- Activate plant defense mechanisms
- Variable ecosystem adaption
- Nutrient uptake
- Mycorrhizal symbiosis

Bach et al., 2020
Research Goal

- The goal of this research is to understand the agroecological benefits of enhancing farm biodiversity through incorporating native flowering plants.

- To determine the difference in the soil microbial communities in the rhizosphere of native plants, problematic weeds, and non-native hedgerow species.

Delory et al., 2016
Site Description

Certified organic vegetable farm in Edinburg, Texas

Soil Characteristics
• PH: ~8.2
• OM%: ~2%
• Total N: 0.08%
• Total C: ~2%
• Salinity (Electric Conductivity): 300uS/cm (non-saline)
Insectary Strip Treatments:

1. Native wildflower mix (17 species) from Douglas King Seeds, San Antonio, TX
   Seeding rate: 10 g/m²

2. Sunn hemp (SH) from Johnny’s Selected Seeds
   Seeding rate: 3.5 g/m²

3. Control (CO) no management
   Common weeds: Amaranthus palmeri and Megathyrsus maximus
Cash Crop

Season 1: Broccoli

Season 2: Hot Peppers
Experimental Design

- CC: Cash crops (4 beds/8 rows)
- Cc: Control
- Sunn hemp
- Natives

- Insectary Strip Composite Sample
- Border Composite Sample
- Cash Crop Composite Sample

*3 m buffer (no plants)*
## Approach and Methods

<table>
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<th>Measurement</th>
<th>Location</th>
<th>Time</th>
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<td><strong>Soil community analysis: DNA &amp; PFLA</strong></td>
<td>1. Middle of insectary strip&lt;br&gt;2. Edge of insectary strip&lt;br&gt;3. Middle of cash crop</td>
<td>Season one and two: 1. Establishment&lt;br&gt;2. Harvest</td>
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<td><strong>Arthropod community dynamics: sticky traps, pitfall traps, and pollinator traps (blue vein)</strong></td>
<td>1. Middle of insectary strip&lt;br&gt;2. Edge of insectary strip&lt;br&gt;3. Middle of cash crop</td>
<td>Season one and two: 1. Pre-planting&lt;br&gt;2. Establishment&lt;br&gt;3. Harvest&lt;br&gt;4. Post-harvest</td>
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<td><strong>Root samples for nematode and mycorrhizae analysis</strong></td>
<td>1. Middle of insectary strips&lt;br&gt;2. Middle of cash crop</td>
<td>Season two: 1. Establishment&lt;br&gt;2. Harvest</td>
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Figure 2. Insect traps set up in each treatment plot at a certified organic farm in Edinburg, TX.
Results – Total Microbial Biomass

• Overall, the total microbial biomass was low in all the treatments.

• No significant difference among the treatments on the total microbial biomass, total bacteria biomass, or total fungal biomass.
Results - AMF

• There was a significant difference between natives and control (P=0.0155) when the insectary strips were more established in March.

• No significant difference between control and sunn hemp or sunn hemp and native.
Results Insect Diversity/Density

- Diptera, Hymenoptera, and Hemiptera were the most abundant.
- Their abundance varies by different treatments.
- Overall, sunn hemp had the highest insect abundance.
Season 1 Yield Results

- No significant differences in the yield of cash crops across the different treatments ($p=0.05$)

- Broccoli heads across all treatments were not marketable due to frost damage.
Pest Damage Assessment

Native wildflower mix had the lowest rate of pest damage compared to Sunn hemp and control.

Overall, pest pressure appeared to be low, and we can assume this was due to the freeze killing the egg.

Figure 5. Average pest damage rate across all treatment (n=30) on a scale of 0-5; 0 indicating no insect damage and 5 indicating severe damage.
Conclusions

• Overall, the natives and sunn hemp performed better than weed control.

• Sunn hemp had higher insect abundance.

• Natives had higher AMF (beneficial microbes) biomass.
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