**Introduction**

- Intensive management practices in Michigan potato production systems have led to degradation in the forms of mineral withdrawal, poor soil structure and soil microbial community disruption.
- Increasing cropping system diversity could lead to improved soil productivity and crop yields (Tiemann et al., 2015; van Elsas et al., 2002), with several studies showing that the combination of grasses and legumes could result in synergistic improvements (Garbeva et al., 2004; Sainju et al., 2005; Altieri et al., 1999; Wagger et al., 1998).
- Grass species, such as pearl millet, have been shown to potentially decrease the pathogens responsible for Potato Early Die (Verticillium dahliae and Pratylenchus penetrans).

**Objective**

- Determine how to best incorporate a grass species into a potato-alfalfa-alfalfa rotation

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**Materials & Methods**

- 2016 Location- Kitchen Farms (Elmira, MI)
- Rotation and opportunities for incorporating grasses

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>JFMAM</td>
<td>JJASON</td>
<td>DJFMAM</td>
</tr>
</tbody>
</table>

- Co-seeded (Plot 1)- Planted at the time of alfalfa seeding in Year 1, June 17th
- Interseeded (Plot 2)- Planted at the first cutting of alfalfa in Year 2- June 17th

**Results: Co-seeding (Plot 1)**

- Loose seed bed and planting difficulties resulted in poor alfalfa stands
- Plot was cut once- August 29
- Final “frost” sampling- October 21
- Weeds were problematic, with no herbicide options for control
- Biomass production ranges (Figure 1)
  - Grasses- 4,700 to 10,000 lbs/A
  - alfalfa- 300 to 1,400 lbs/A
  - Weeds- 600 to 4,600 lbs/A
- Grasses will either winter kill or be terminated with glyphosate. In 2018 Plot 1 will be alfalfa and in 2019 it will be planted to potatoes
- Future management considerations:
  - Increase alfalfa seeding rates
  - Reduce grass seeding rates
  - Plant grass later, after glyphosate application to alfalfa, to reduce weed pressure

**Results: Interseeding (Plot 2)**

- Cuttings- June 15, July 15, and August 9
- Plot terminated- August 30
- Weed pressure was low due to 2015 glyphosate applications to Year 1 alfalfa (no grasses planted yet)
- Season total grass biomass production ranged from 16 to 775 lbs/A, with pearl millet ‘Tifleaf3’ producing the most (Figure 3)
- Average alfalfa biomass for the season was 3,025 and 1,775 lbs/A for the above- and belowground portions, respectively
- In 2018 Plot 2 will be planted to potatoes, with a focus on microbial community, soil nutrient, and Potato Early Die pathogen assessments, in addition to potato quality and yield
- Future management considerations:
  - Increase grass seeding rates
  - Alter cutting times to the advantage of the grass species to reduce early shading and increase total biomass production

**Conclusions**

- Grasses were successfully grown when co-seeded with alfalfa or interseeded into 2nd year alfalfa
- Pearl millet varieties differed in their performance under these two planting scenarios, with ‘Tifleaf3’ out producing ‘CFPM101’ and ‘Millex32’ under intense competition from alfalfa (Plot 2- interseeded) and producing slightly lower biomass relative to those same varieties under reduced competition (Plot 1- co-seeded)
- Continued research will lead to recommendations for increasing crop diversity in potato-alfalfa rotations

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**Figure 1.** Plot 1 season total dry biomass (above- + belowground) for co-seeded grass species, alfalfa, and weeds. Differing letters indicate differences among grass biomass (p<0.05).

**Figure 2.** Sorghum sudangrass, teff, and alfalfa alone (left to right) at the time of cutting August 29

**Figure 3.** Plot 2 season total dry biomass (above and belowground) for interseeded grass species. Differing letters indicate differences among total grass biomass (p<0.05).

**Figure 4.** Pearl millet ‘Tifleaf’, teff, and annual ryegrass (left to right) next to alfalfa at the third cutting time on August 9

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**Table 1.** Cover crop treatments and seeding rates

<table>
<thead>
<tr>
<th>Grass</th>
<th>Variety</th>
<th>Co-seeded</th>
<th>Interseeded</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>—Seeding rate (lbs/A) —</td>
<td></td>
</tr>
<tr>
<td>Pearl millet</td>
<td>CFPM101</td>
<td>7.5</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Millex32</td>
<td>7.5</td>
<td>15</td>
</tr>
<tr>
<td>Sorghum-sudangrass</td>
<td>Sweetbites</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>Teff</td>
<td>Dessie</td>
<td>2.5</td>
<td>5</td>
</tr>
<tr>
<td>Annual ryegrass</td>
<td>Centurion</td>
<td>10</td>
<td>12.5</td>
</tr>
<tr>
<td>Cereal rye</td>
<td>Guardian</td>
<td>30</td>
<td>60</td>
</tr>
<tr>
<td>Alfalfa alone</td>
<td>Roundup Ready</td>
<td>12.5</td>
<td>12.5</td>
</tr>
</tbody>
</table>

- Both plots were under irrigation and alfalfa was not removed upon cutting (4” height)
- Aboveground biomass was sampled at each cutting date; at the frost/termination above- and belowground biomass were sampled (0.25 m², depth = 18”)
- Randomized complete block (4 replications)