# Cover Crop Diversity Research Assessment Observations

On August 9, 2018, six invited farmers and/or agricultural service providers attended our Cover Crop Diversity Project on-farm research assessment to assess our research plots at a local farm.

# Research Assessment Observations

At that farm, the biological science team planted nine cover crops plus a weedy control plot and replicated that four times. All of the cover crops were planted about 7 weeks prior to the assessment. To minimize participant bias, we labeled the plots from 1 to 10 so the participants would not know which treatments they were assessing. Each participant was assigned one of the four blocks to assess and ranked all ten plots within their assigned block on a scale of 1 to 5 regarding five traits about the cover crop and weeds present.

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| **1. Cover Crop Canopy Closure:**  Please rate the **canopy closure of the cover crops** for each plot on a scale of 1 to 5 where 1 is very little cover crop canopy closure and 5 is complete cover crop canopy closure. | |
| **Variety** | **Average Score** |
| US-1136 | 4 |
| Tropic Sun | 3.5 |
| US-1138 | 3.5 |
| Sanni | 3.5 |
| US-1137 | 3.17 |
| AU Golden | 3 |
| Iron Clay | 1.83 |
| Red Hemp | 1.17 |
| Weedy Control | 1 |
| PI 274767 | 1 |

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| --- | --- |
| **2. Cover Crop Vigor:**  Please rate the **cover crop vigor** (the overall growth and development of the cover crop) in each plot on a scale of 1 to 5 where 1 is very low cover crop vigor and 5 is very high cover crop vigor. | |
| **Variety** | **Average Score** |
| Sanni | 4 |
| US-1138 | 3.83 |
| US-1136 | 3.83 |
| US-1137 | 3.67 |
| Tropic Sun | 3.67 |

|  |  |
| --- | --- |
| AU Golden | 3.17 |
| Iron Clay | 2 |
| PI 274767 | 1.33 |
| Red Hemp | 1.17 |
| Weedy Control | 1 |

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| --- | --- |
| **3. Cover Crop Biomass Accumulation:**  Please rate the **biomass accumulation of the cover crop** (the total vegetative material in the cover crop) in each plot on a scale of 1 to 5 where 1 is very low cover crop biomass accumulation and 5 is very high cover crop biomass accumulation. | |
| **Variety** | **Average Score** |
| US-1138 | 4 |
| US-1136 | 4 |
| Sanni | 3.83 |
| Tropic Sun | 3.67 |
| AU Golden | 3.67 |
| US-1137 | 3.33 |
| Iron Clay | 2.17 |
| Red Hemp | 1.17 |
| Weedy Control | 1 |
| PI 274767 | 1 |

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| --- | --- |
| **4. Weed Coverage:**  Please rate the **coverage by weeds** for each plot on a scale of 1 to 5 where 1 is minimal weed coverage and 5 is excessive weed coverage. | |
| **Variety** | **Average Score** |
| Weedy Control | 5 |
| PI 274767 | 4.17 |
| Red Hemp | 4 |
| Iron Clay | 3.67 |
| AU Golden | 3 |
| Tropic Sun | 2.83 |
| Sanni | 2.83 |
| US-1137 | 2.33 |
| US-1138 | 2.17 |
| US-1136 | 1.67 |

|  |  |
| --- | --- |
| **5. Weed Vigor:**  Please rate **weed vigor** (the overall growth and development of the weeds) in each plot on a scale of 1 to 5 where 1 is very low weed vigor and 5 is very high weed vigor. | |
| **Variety** | **Averaged Score** |
| PI 274767 | 4.67 |
| Weedy Control | 4.33 |
| Iron Clay | 4 |
| Red Hemp | 4 |
| AU Golden | 3 |
| Tropic Sun | 2.33 |
| US-1137 | 2.17 |
| US-1138 | 2.17 |
| US-1136 | 2.17 |
| Sanni | 1.83 |

# Advantages and Disadvantages of the Cover Crops

After all of the observation forms were completed in the field, the research participants and facilitators relocated to a covered discussion area. The participants were asked to consider the overall performance, effects of the cover crops, weed suppression, and any other positive or negative effects they observed in the field. Each participant was given two green stickers and two red stickers to vote for the two cover crops that show the most potential for weed suppression (greens stickers) and the two cover crops that show the least potential for weed suppression (red stickers). The three cover crops identified as having the most potential to suppress weeds are US-1138 (cowpea), US- 1136 (cowpea), and Sanni (Sunn hemp). The three cover crops identified as having the least potential to suppress weeds are the weedy control (no cover crop planted), PI- 274767 (slenderleaf rattlebox), and red hemp (slenderleaf rattlebox). Below is a table summarizing the votes.

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| --- | --- | --- |
| **Cover Crop** | **Green Votes**  (show the most potential for weed suppression) | **Red Votes**  (show the least potential for weed suppression) |
| Iron Clay | 0 | 0 |
| Red Hemp | 0 | **3** |
| US-1137 | **1** | 0 |
| Weedy Control | 0 | **4** |
| PI-274767 | 0 | **4** |
| Tropic Sun | 0 | 0 |
| US-1138 | **4** | **1** |
| AU Golden | **1** | 0 |
| US-1136 | **2** | 0 |

|  |  |  |
| --- | --- | --- |
| Sanni | **2** | 0 |

After the participants voted, they shared their observations and identified the positive and negative characteristics of each of the cover crops that received a green or red vote. Below is a table summarizing the traits identified.

|  |  |  |
| --- | --- | --- |
| **Cover Crop** | **Positive Characteristics** | **Negative Characteristics** |
| Iron Clay |  |  |
| Red Hemp |  | * Low cc vigor, High weed vigor * Low cc biomass * High weed coverage/biomass |
| US-1137 | * Good biomass |  |
| Weedy Control |  | * Very weedy * Poor establishment * Little cc * Bare ground visible in block 2 |
| PI-274767 |  | * Poor cc germ, Lower cc vigor * Lots of weed growth * Small cc plants * Mostly weeds present (Lots of grasses in block 2) |
| Tropic Sun |  |  |
| US-1138 | * Most biomass * Best weed suppression * Best canopy closure * Healthy vigorous | * Not great in block 3 |
| AU Golden | * High cc biomass, High cc vigor, Most flowers, High cc canopy closure |  |
| US-1136 | * Good cc canopy closure * High cc vigor, High cc biomass |  |
| Sanni | * High cc biomass, High weed suppression * High cc vigor, least Sunn hemp flowers |  |

# Desirable Cover Crop Breeding Traits

We asked the participants to identify the desirable traits of the most promising cover crops in our experiment and the undesirable traits of the least promising cover crops in our experiment. Below is a table summarizing their comments.

|  |  |
| --- | --- |
| **Desirable Traits** | **Undesirable Traits** |
| * Weed suppression * Reducing new weed seeds * Not becoming a weed in subsequent seasons * Not a nematode host plant/does not increase nematode pressure * High nitrogen fixation * High biomass * Low seed cost * Does not deplete soil moisture | * Poor germination * Poor stand establishment |

# Cover Crop Performance within Species

After reviewing their observation forms and the group discussion notes, the participants ranked from best to worst the performance of the cover crops within each species. We then assigned scores to each ranking to determine an overall score for each cover crop. The assigned scores varied between cover crop species depending on the number of accessions grown. Below is a table summarizing the scores.

|  |  |
| --- | --- |
| **Sunn Hemp Ranking** | **Sunn Hemp Score (points)** |
| 1 | 3 |
| 2 | 2 |
| 3 | 1 |
|  | |
| **Cowpea Ranking** | **Cowpea Score (points)** |
| 1 | 4 |
| 2 | 3 |
| 3 | 2 |
| 4 | 1 |
|  | |
| **Slenderleaf Rattlebox Ranking** | **Slenderleaf Rattlebox Score (points)** |
| 1 | 2 |
| 2 | 1 |

Not all participants ranked each cover crop so we calculated the average score based on the number of participants that ranked each of the cover crops. None of the participants ranked the Slenderleaf Rattlebox accessions due to poor performance overall. The most highly ranked accessions were cowpea – US 1138, cowpea – US 1136, and Sunn hemp – Sanni. Below is the summary of rankings and scores for each accession.

|  |  |  |
| --- | --- | --- |
| **Rank from *best to worst* the performance of the cover crops within each species (Sunn hemp, Cowpea, Slenderleaf Rattlebox).** | | |
| **Sunn Hemp** | **Total Score (points)** | **Averaged Score (Out of 3 points)** |
| Sanni | 12 | 3 |
| Tropic Sun | 8 | 2 |
| AU-Golden | 4 | 1 |
|  | | |
| **Cowpea** |  | **Averaged Score (Out of 4 points)** |
| US-1138 | 13 | 3.25 |
| US-1136 | 13 | 3.25 |
| US-1137 | 8 | 2 |
| Iron Clay | 6 | 1.5 |
|  | | |
| **Slenderleaf Rattlebox** |  | **Average Score** |
| PI 274767 | N/A | N/A |
| Red Hemp | N/A | N/A |

# Alternative Cover Crops

The participants identified alternative cover crops for the research team to consider to improve cover crop research in the future. Below is a list of the alternative cover crops identified.

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| **Alternative Cover Crops** |
| Velvet bean |
| Sesame |
| Sesbania (identified as root knot nematode sensitive) |
| Pigeonpea (slow to get started) |
| Chia seed |
| Mungbean |
| Blue lupine |

# Future Research Direction

The participants listed areas of cover crop research that could potentially be addressed by a breeding program. The suggestions are summarized in the table below.

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| **Future Areas of Research** |
| Earliness of cover crops before cash crop in spring (day length issue for late planted winter cover crops) |
| Nematode resistance (root knot, sting, stubby root) |
| Compatibility/benefits of cover crop mixes |
| Nitrogen production |

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| Tonnage per acre |
| Seed cost, availability and supply, and re-seeding potential |
| Regional seed production to match local climate/soil and to reduce freight cost |
| Positive impacts of weed cover crops in the mix of cash crop production |
| Effectiveness of winter legumes in poor sandy soil (lupine/winter pea) |