Objectives: Determine 1) biomass production of green manures: red clover and balansa clover intercropped with cereal rye and a mix seeded after cereal rye harvest; 2) grazing value of green manures; 3) corn yield responses to green manures; 4) potential for green manures to reduce N fertilizer rate.

Hypotheses: Provided timely summer rainfall, the summer mix will produce the most biomass and grazing value. The clovers will provide more atmospherically-fixed N to the succeeding corn crop. Under ideal growing conditions, the grazing value of the summer mix will offset its greater cost of establishment as well as its lower N value. Under stressed or average growing conditions, one or both of the clovers will provide more value through fall forage harvest and reduced N requirements of the succeeding corn.

Farmer-Cooperator will:
- Follow Research Protocols in accordance with Project Design, Data to Collect and Timeline detailed below.
- Take photos throughout the project. Try to capture photos that depict the differences you observe among the treatments.
- Keep in contact with PFI with updates and questions.
- Turn in data and complete post-project survey by November 2021.

Practical Farmers of Iowa will:
- Help set up research protocol, monitor progress of project and provide support when needed.
- Publish results in a PFI research report, on PFI website and potentially other outlets.
- Provide $550 research honorarium to cooperator upon receipt of data.

Project Design:

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red clover</td>
<td>Frost-seed red clover to existing cereal rye crop in late winter/early spring.</td>
</tr>
<tr>
<td>Balansa clover</td>
<td>Frost-seed balansa clover to existing cereal rye crop in late winter/early spring.</td>
</tr>
<tr>
<td>Mix</td>
<td>Drill-seed mix following cereal rye harvest in July.</td>
</tr>
</tbody>
</table>

- Apply these three treatments in a replicated trial: at least four replications of strips.
  - 3 treatments x 4 replications = 12 strips total.
- Strips must be at least as wide as one combine pass and should run the length of the field.
  - Example layout:

```
Red clover  |  Balansa clover  |  Mix  |  Red clover  |  Balansa clover  |  Mix  |  Red clover  |  Balansa clover  |  Mix
REP 1       |  REP 2           |  REP 3|  REP 4       |
```
Data to Collect (cooperator):

- Green manure cover crop biomass
  - In fall, sample aboveground biomass from each strip.
    - Randomly place 1’x1’ PVC square in strip
    - Use shears to clip all aboveground plant material from within the square
    - Place all samples from a single strip into one paper bag
      - (e.g., one paper bag per strip)
    - Label paper bags accordingly
      - Cover crop: red clover, balansa clover or mix
      - Number of squares sampled from (e.g., 3 squares = 3 ft²)
      - Date of collection
  - Send paper bags to PFI office
    - Samples will be dried and weighed
    - Grazing value will be estimated: [https://www.extension.iastate.edu/agdm/crops/html/a1-91.html](https://www.extension.iastate.edu/agdm/crops/html/a1-91.html)

- Corn grain yield
  - Harvest and record grain yield and moisture from each strip.

- Optional: Late-spring soil nitrate test (LSNT)
  - When the corn is 6-12 in. tall, collect soil cores to a depth of 12 in. from each strip.
    - Sample collection protocols from ISU:
      - [https://store.extension.iastate.edu/Product/Use-of-the-Late-Spring-Soil-Nitrate-Test-in-Iowa-Corn-Production](https://store.extension.iastate.edu/Product/Use-of-the-Late-Spring-Soil-Nitrate-Test-in-Iowa-Corn-Production)

Project Timeline:

<table>
<thead>
<tr>
<th>Fall 2019</th>
<th>Spring 2020</th>
<th>Summer 2020</th>
<th>Fall 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Seed entire field with cereal rye cover crop.</td>
<td>• Frost-seed red and balansa clovers to rye crop.</td>
<td>• Harvest rye crop. • Drill-seed mix. • Take photos.</td>
<td>• Collect green manure biomass. • Graze cattle. • Take photos.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spring 2021</th>
<th>Summer 2021</th>
<th>Fall 2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Terminate green manure cover crops. • Plant corn. • Take photos.</td>
<td>• Optional: collect LSNT soil samples. • Optional: split strips o Typical N rate o LSNT recommended N rate</td>
<td>• Harvest corn from all strips. • Turn in data and photos. • Take post-project survey</td>
</tr>
</tbody>
</table>

Contact: Stefan Gailans, Research and Field Crops Director, (515) 232-5661; stefan@practicalfarmers.org

The terms of this Research Protocols document are subject to the terms of the individual Research Cooperator’s Memorandum of Understanding agreement with PFI. To the extent these terms may differ or conflict, the Memorandum of Understanding shall control.