Effects of Green Manure on Soil Conservation in Taiwan

Lee-ying Cheng
Seed Improvement and Propagation Station, Taiwan

Contents
1. Foreword
2. The characteristic and effects of green manure
3. Introduction of green manure crops in Taiwan
4. Application of green manure crops in Taiwan
5. Ways to plant and utilize green manure crops in Taiwan
6. A successful green manure cropping model
Foreword

The cropping index in Taiwan is high and the farmland soil fertility bears heavy load.

First cropping season: Feb - Jun
Second cropping season: Jun - Oct
Winter cropping season: Oct - Jan

The challenge: how to implement smart way of using fertilizers through the application of green manure.

Characteristic of green manure

1. Easy to plant and maintain its vigorous condition under low input cultivation
2. Seeds can be bought at a cheap price and only needs low amount of fertilizer
3. Leaves flourish and yield high grass mass
4. Contains high fertilizer ingredients and can easily decompose
5. Deeply rooted and can improve soil’s physical properties as well as absorption of subsoil nutrients
6. No adverse effects on subsequent or nearby crops while growing and also on the soil after the green manure is buried
Effects of green manure crops

1. Inhibit the growth of weeds and contribute to the maintenance of farmland environment

- Slow soil erosion during rainy season, reduce soil moisture evaporation during dry season

Applied to the idle mine ground

Applied to the sloping ground in orchards

Effects of green manure crops

1. Inhibit the growth of weeds and contribute to the maintenance of farmland environment

- Prevent weeds, Improve farm landscape

Perennial peanut

Sunflower
Effects of green manure crops

2. Release fertilizer elements for subsequent crops

- Suitable soil environment:
  - Neutral, temperature 20-30 °C, Soil moisture content 50-90%

- About 2 weeks for decomposition

Effects of green manure crops

3. Improve the soil's physical and chemical properties

- Soil's physical properties:
  - Soil porosity ↑, Soil aeration ↑, Soil water holding capacity ↑

- Soil's chemical properties:
  - Increased cation exchange capacity and improve the effectiveness of fertilizer
  - The organic metabolites with metal ions form compound to promote the release of phosphate
The introduction of green manure crops in Taiwan

1. Winter annual green manure crops
   - Rape, Egyptian clover, vetch, lupine, Red oats, ryegrass

2. Summer annual green manure crops
   - Sesbania, Sunhemp, Soybean, Niger
The introduction of green manure crops in Taiwan

3. Perennial green manure crops

Growth period: Perennial

Lablab, Velvet bean

The application of green manure crops in Taiwan

1. Rotation

Short-term rotation during winter cropping season

- Between second cropping season and next first cropping season

First cropping season | Second cropping season | Winter cropping season

Feb | Jan | Oct | Jan

Around 2-3 months

Annual winter green manure crops are appropriate
# The application of green manure crops in Taiwan

## Fallow farmland rotation during first or second cropping season

<table>
<thead>
<tr>
<th>First cropping season</th>
<th>Second cropping season</th>
<th>Winter cropping season</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feb</td>
<td>Jun</td>
<td>Oct</td>
</tr>
</tbody>
</table>

- **First cropping season**: Through 4-5 months, Note pest control
- **Second cropping season**: Annual winter green manure crops are appropriate when planted in Feb.
- **Winter cropping season**: Annual summer green manure crops are appropriate when planted in Mar. or Apr.

## 2. Intercropping

- Common in tea gardens or orchards

Vetch

Soybean Tainan No.7
Ways to plant and utilize green manure crops in Taiwan

1. Select the appropriate green manure crops

- Fallow farmland rotation during first cropping season:
  Sesbania, Sunhemp, Soybean, Niger, Egyptian clover

- Fallow farmland rotation during second cropping season:
  Sesbania, Sunhemp, Soybean, Niger

- Short-term rotation during winter cropping season:
  Rape, Egyptian clover, vetch, lupine, Red oats, ryegrass

2. Implement appropriate planting methods

- Soil preparation
  - For the first cropping season, practice rotation or intercropping
  - usually plough too deep to affect green manure crop seed germination

- planting soybean as green manure crop in the first crop season
  by soil preparation produced the most amount of fresh mass
  less than 20 tons per hectare and the fertilizer supply for
  subsequent crop -rice reduced only 9-21% compared with
  general fertilizer supply of rice.
Ways to plant and utilize green manure crops in Taiwan

2. Implement appropriate planting methods

No soil preparation

For the second or winter cropping season rotation, seeds germinate on the soil surface and in rice straw mulching, it can keep the soil moist and resulted in seed germination quickly and neatly.

planting Egyptian clover by no soil preparation method in the winter cropping season produced the amount of fresh mass usually more than 20 tons per hectare and the fertilizer supply for subsequent crop - rice reduced 23-32%.
Ways to plant and utilize green manure crops in Taiwan

3. Implement the necessary field management

- Water Management
  - Especially in seed germination
  - The sunhemp is the most drought-tolerant green manure crop whereas the Sesbania is the most flooding-tolerant green manure crop

- Pest Control
  - The most severe: Sesbania, Rape

Ways to plant and utilize green manure crops in Taiwan

3. Select the appropriate time to plough

- Flowering to early pod
  - Because it is hard to plough after turning woody · Sesbania needs to be ploughed before it turns woody
  - To completely decompose green manure plant require ploughing for two weeks before planting subsequent crops
Ways to plant and utilize green manure crops in Taiwan

4. Reduce the fertilizer of subsequent crop

- Estimate the amount of fertilizer elements released by green manure and then reduce the amount of fertilizer in the subsequent crop.
- This, however, is always complicated for farmers to perform.
- Simple operation method
  - Confirm there are more than 20 tons of fresh mass of green manure in the field.
  - Reduce 50% amount of basal fertilizer at soil preparation before planting subsequent crop.
  - Adjust the amount of fertilizer at different growth period when necessary.
  - Fertilizer might be insufficient in the early to middle growth period.

A successful green manure cropping model

- Generally speaking, planting green manure crops can reduce the supply of chemical fertilizers and have a positive effect on soil conservation efforts.
- The important issue is how to configure different crops or varieties in cropping systems in order to reduce green manure planting costs and promote the benefit of green manure to the crops needed and then improve the crop rotation system revenue.
The Nitrogen content change of soil in different rotation cropping model

I: 2012 Before first cropping season  IV: 2013 Before first cropping season
II: 2012 Before second cropping season  V: 2013 Before second cropping season
III: 2012 Before winter cropping season  VI: 2013 Before winter cropping season

Model A: 2012 first cropping season second cropping season winter cropping season 2013 first cropping season second cropping season winter cropping season
Rice → Rice → Feed corn → Rice → Feed corn
(early variety) (early variety)

Model B: 2012 first cropping season second cropping season winter cropping season 2013 first cropping season second cropping season winter cropping season
Rice → Green manure → Feed corn → Green manure → Rice → Feed corn
(late variety) (early variety)

Model C: 2012 first cropping season second cropping season winter cropping season 2013 first cropping season second cropping season winter cropping season
Green manure → Rice → Feed corn → Green manure → Rice → Feed corn
(late variety) (late variety)

The Phosphate content change of soil in different rotation cropping model

I: 2012 Before first cropping season  IV: 2013 Before first cropping season
II: 2012 Before second cropping season  V: 2013 Before second cropping season
III: 2012 Before winter cropping season  VI: 2013 Before winter cropping season

Model A: 2012 first cropping season second cropping season winter cropping season 2013 first cropping season second cropping season winter cropping season
Rice → Rice → Feed corn → Rice → Feed corn
(early variety) (early variety)

Model B: 2012 first cropping season second cropping season winter cropping season 2013 first cropping season second cropping season winter cropping season
Rice → Green manure → Feed corn → Green manure → Rice → Feed corn
(late variety) (early variety)

Model C: 2012 first cropping season second cropping season winter cropping season 2013 first cropping season second cropping season winter cropping season
Green manure → Rice → Feed corn → Green manure → Rice → Feed corn
(late variety) (late variety)
The Potash content change of soil in different rotation cropping model

The change in PH value of soil in different rotation cropping model
The change in EC value of soil in different rotation cropping model

<table>
<thead>
<tr>
<th>Model</th>
<th>2012 First cropping season</th>
<th>2012 Second cropping season</th>
<th>2012 Winter cropping season</th>
<th>2013 First cropping season</th>
<th>2013 Second cropping season</th>
<th>2013 Winter cropping season</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Rice</td>
<td>Rice</td>
<td>Feed corn</td>
<td>Rice</td>
<td>Rice</td>
<td>Rice</td>
</tr>
<tr>
<td></td>
<td>(early variety)</td>
<td>(late variety)</td>
<td></td>
<td>(early variety)</td>
<td>(late variety)</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Rice</td>
<td>Green manure</td>
<td>Feed corn</td>
<td>Rice</td>
<td>Rice</td>
<td>Feed corn</td>
</tr>
<tr>
<td></td>
<td>(late variety)</td>
<td></td>
<td>(early variety)</td>
<td>(early variety)</td>
<td>(late variety)</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Green manure</td>
<td>Rice</td>
<td>Feed corn</td>
<td>Green manure</td>
<td>Rice</td>
<td>Feed corn</td>
</tr>
<tr>
<td></td>
<td>(late variety)</td>
<td>(late variety)</td>
<td></td>
<td>(late variety)</td>
<td>(late variety)</td>
<td></td>
</tr>
</tbody>
</table>

A successful green manure cropping model

- reduce green manure planting costs: no soil preparation
- promote the benefit of green manure to the needs of subsequent crop: increase the nitrogen content in soil and reduce 20% supply of chemical fertilizers for feed corn
- 25% increase in feed corn yield
Thank you for your attention