The Importance of Rotations and Green Manure Cover Crops in Conservation Agriculture

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Principles of Conservation Agriculture

- Minimum soil disturbance
- Residue retention
- Crop rotation
- Green manure cover crops
Difference between crop rotations and monoculture

**Crop rotation**
- A repetitive sequence of crops in the same place following a defined order.

**Monoculture**
- The repeated planting of the same crop or crops in the same place year after year. Each year, the same crop or crops are sown in the same field.
Problems associated with monocultures

- Reduction of crop diversification
- Decrease in plant nutrients due to the continuous exploration of the same soil zone
- Decrease in root development
- Change in biological activity of the soil
Problems associated with monocultures cont…

- Increase in soil-born diseases and crop specific pests
- Increase in specific weeds (generally of the same class)
- Accumulation of allelopathic toxins
- Monoculture leads to degradation
Cassava in monoculture over 14 years

Cassava in rotation with improved fallow
Effects of rotation on fungal root diseases in wheat

W - Wheat
L - Lupines
O - Oats
F - Fallow
Basic principles of crop rotations

- A rotation is better than monoculture no matter if there is a legume included in the rotation (i.e. maize-wheat, maize-cotton)
- We can expect the best return if we include a legume in the rotation
- The rotation of crops is not sufficient in tropical areas to maintain productivity – extracted nutrients have to be replaced
Maize yield response in different CA and conventional treatments, Monze FTC, Zambia, 2006-2008
Comparative advantages of rotations

- Pest and disease control
- Weed control
- Increase in biological activity
- Soil improvement (structure, organic matter)
- Positive effects of rotations on succeeding crops
- Higher overall yields
Influence of increasing levels of N on wheat yield cultivated in long-term monoculture and crop rotation.
Rotations are site-specific!

Rotations depend on:

- Environment i.e. climate, soils, altitude
- Socioeconomic preferences
- Markets and trade-offs
- Risk involved
- Tradition
Some maize-based crop rotations on small-holder farms in Southern Africa

- Typical rotations in the region:
  - Maize - Cotton
  - Maize – Cotton – Soybean
  - Maize – Groundnut
  - Maize - Soybean

- Other possibilities:
  - Maize – Cotton - Sunhemp
  - Maize – Cotton – Cowpea
  - Maize – Sunflower - Beans
Factors to take into account in designing a crop rotation

- Effects on the succeeding crop:
  - Water
  - Nitrogen
  - Weeds
  - Pests and diseases
  - Allelopathic toxins
  - Root type and distribution
  - Residue amount for subsequent crop

- Seeding and harvest times

- Crop prices and productivity in the medium term

- Risk involved in each crop
Effects of different rotation both in CA and CP on infiltration rate
Potential crops in rotations

Maize (Zea mais)
Potential crops in rotations

Sunflower
Potential legumes in rotations

Soybean (*Glycine max*)
Potential legumes in rotations...

Cowpea (*Vigna unguiculata*)
What are Green manure cover crops?

Green manure cover crops

- Crops that are normally planted as inter- or relay crops for the sake of accumulating nitrogen in the soil, producing residues and ground cover. GMCCs are not primarily planted to generate additional incomes (seed or grains).
Reasons for taking green manure cover crops

- To produce nitrogen (legumes)
- To control weeds (replacing fallow periods)
- To produce mulch during non-crop periods
- To cycle soil nutrients
- Other positive effects on succeeding crops
Typical green manure cover crops in Southern Africa

Sunhemp (*Crotalaria juncea*)
Typical green manure cover crops in Southern Africa

Pigeon pea (Cajanus cajan)
Considerations before selecting green manure cover crops

- Yield effects on succeeding cash crops
- Rapidity of growth and ground cover
- Nitrogen content and Carbon/Nitrogen ratio
- Ability to produce yields without fertilizer applications
- Influence on weeds
- Resistance to diseases and pests
Effects of green manure cover crops on weed establishment after 12 and 27 days
Green manure cover crops in practice – as sole crops or intercropped

Maize – *Crotalaria grahamiana* intercropping

Maize – Cowpea intercropping
Green manure cover crops in practice – the importance of timing

Maize – Velvet bean intercropping planted at the same time

Maize – Velvet bean intercropping, planted six weeks after maize
Post-harvest Management

Intercropped Mucuna can continue growing after harvest
Benefits of deep rooting legumes

Deep rooting Pigeon Pea (*Cajanus cajan*) intercropping to break hardpans
When is it useful to plant green manure cover crops?

- When there is not enough water for a cash crop
- When there is a free period between crops and enough moisture available or at the end of the maize cropping season
- When additional residues need to be generated
- When producing a cash crop is not profitable or too risky
Thank you!