

# **WORLOCSNGRESS6** on CONSERVATION AGRICULTURE

Winnipeg, Manitoba 23-29 June (+ post-conference tour to USA)

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- Perspectives from congress
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  Programme at Grain SA / The maize Trust

#### WCCA Goal

Provided an opportunity to share ideas and learn from international colleagues on how conservation agriculture can be a success.

"WCCA impacts agriculture because everyone shares their ideas freely and openly, regardless if you are from academia or another hemisphere, or have a farm or work in policymaking.

Our goal is to share ideas that have practical application and can be put to work improving soil health as well as benefiting the farmer and society."

**SRAAN** S

Jerry Hatfield, USDA - Agricultural Research Service WCCA programme chair

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#### WCCA Themes



#### Growing more, more efficiently

- Improve soil quality.
- Increase efficient use of inputs (labour, nutrients, water).
- Increase cropping system diversity. And more.
- Climate resilient systems
- Increase Adoption Through Innovation
  - Knowledge Sharing and Faster Implementation



#### **WCCA Keynote Speakers**

- 'Rebuilding soil is crucial for the future of civilisation' David Montgomery
- 'Use science and reason, not emotion and rumours' – Dwayne Beck
- '80% of input costs in agriculture are energy related.....' - Dwayne Beck
- 'Focus on systems, not details; outputs, not inputs' - Dwayne Beck
- 'Is the weather bad? or is your soil bad?'
  *Dwayne Beck*
- 'If tillage was good for eliminating weeds they'd all be gone by now' -Dwayne Beck
- 'Sustainable agriculture is essential for feeding the world's population' – *Howard Buffet*

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#### **FUTURE OPPORTUNITIES IN CA**

#### PERSPECTIVES FROM CONGRESS AND PROGRAMME COMMITTEE



#### **SOIL HEALTH AND BIOLOGY**

- Soil health may be one of the key outcome indicators, but general need for improved indicators
- Farmers need to understand soil biology
- Get soil biology right and reduce inputs







- Drivers are the same in all countries
- Status quo is not an option
- Often step-wise adoption of CA, need to take first step
- Need to meet farmers where they are and focus on relevant solutions
  - "all learning starts from what you know"



## COMPONENTS OF SUSTAINABILITY USING CA

- CA adoption is far advance in some countries, but crop diversity is lacking behind
  - Need more crop diversity & better info on managing Cover Crops
- Africa just starting and gaining momentum
- Farmers will need better advice and new skills, since CA is knowledge intensive
- Farmers need to work together, but also understand their consumer needs
- Africa: need for small-scale mechanisation,
  some good examples.



# CA AND CLIMATE CHANGE The Maize Trust

- Principles of CA contribute to the resilience of farming systems to climate change
  - more soil water in dry periods / seasons
- Climate change an issue in USA

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- Climate change should be used to market CA
- GHG emissions should be assessed
- No-till alone cannot sequester C should feed soil through CCs
- CA can smooth heat waves above surface temp is 2.5 deg lower than ploughed soils.

#### TECHNOLOGY

- PROGRESS: No-till Controlled-traffic GPS auto steer -Yield Monitors - Satellite Imagery - Topography mapping & drainage
- GIS based yield map 1st thing farmers should start to use. What are the causes of yield gaps on the map? What overlaps with gaps? What should be done to close gaps?

#### Next steps:

- Managing different soil types differently
- Controlling water drainage and erosion
- Nutrient availability / soil acidification
- Pest/diseases managed spatially



Removing man-made factors such as machinery faults, soil compaction, and poor irrigation.

# **TECHNOLOGY (cont)**



 Variable Rate (VR) for nutrient / lime application based on soil types and performance of previous season

#### **Question:**

- Do you apply more or less on poor/better soils (through VR application)?
- Some try to build-up poor soils cost:benefit ratio positive





# **TECHNOLOGY (cont)**

- Farm yields are approaching biophysical yield limits
- Precision Agriculture propel agriculture into the computerised info-based world, and is designed to help farmers ...
- NRCS Precision Nutrient Management practices:
  - Yield monitoring
  - Manure relocation
  - Split application of N
  - Late season Maize Stalk N test
  - Cover crop planting
  - Precision or grid soil sampling
  - Variable Rate P and K
  - Pre-side dress N test





#### **Post-conference tour to USA**

#### North and South Dakota



# **CA according to USDA**

- Minimising soil disturbance
  Constant of the second se
- 2. Energise with diversity
- 3. Keep the soil covered
- 4. Maximise living roots

- . Minimal mechanical soil disturbance
- 2. Diversified cropping
  - Including cover crops
- 3. Permanent organic soil cover – Mulching (FAO)



#### CA systems & general

- Have a long-term view / vision
- General aim:
  - Building NR (soil) is the big concern / focus, not yield
  - Cut-down on external inputs as far as possible
- "Must remove all synthetic fertilisers to be truly sustainable requires very high soil health" – some don't use fertilisers for many years
- "Stacked enterprises" integrating various enterprises, e.g. croplivestock system – produce too much grain in world
- Working with Mother Nature, Rules of ecology 'everything is connected', let nature do it
  - If you have a problem, what have you done wrong that nature tries to correct?
- In 100 years we will have to be 0% fossil fuel
- What is holding farmers back in USA?
  - Fear of unknown
  - Government system (subsidies)
- Very little, if any, insecticides





#### Designing agricultural systems by mimicking nature



3. Production et restitution au sol d'une forte biomasse par des plantes multi-fonctionnelle en associations et/ou successions

#### **Soil Health and Fertility**

<u>Soil Health</u>: The continued capacity of the soil to function as a vital living ecosystem that sustains plants, animals and humans.

Soil Renaissance Plan, USDA

- "... cannot really describe or define it, but we know one when we see one"
- 'How can we test it?' (see Rick Haney's work)
- 'Must treat soils as we treat all other living things on earth with respect' – "Rights of Nature"
- Soil is the heart of the system 'take care of the land and the land will take care of you' – Hugh Hammond Bennett, 1950
- Can afford to use less fertilisers, but higher yields due to healthier soils and higher root systems (nutrient cycling)
  - Fertility levels are just rising

- Are the nutrients cycled or "leaked"? 'Ecosystems that leak nutrients (including carbon) for extended periods of time, turn into deserts.'
- Move away from idea that the soil acts more or less like a static recipient of nutrients or bank where ...
  - farmers' "money" is constantly leaking out of the "bank".
  - 'Adding chemical mixtures to soils without organic matter is INEFFICIENT'
- Move towards finding or creating a higher natural fertility within that soil, through higher SOM, in which to apply a much smaller dose of (organic or inorganic) nutrients

- Adding huge net quantities of high-nutrient rich biomass (below-ground) where it is highly accessible to subsequent crops.
  - What is needed is a constant supply of even a very small but well-balanced amount of nutrients over time, and the unobstructed access of plant roots to these nutrients.
- SOM can and does supply low to medium concentrations of nutrients, and almost always in wellbalanced quantities.

<u>Conclusion</u>: Integrated Biological-Chemical approach to restore and maintain soil fertility

- Increase resilience and accelerate build-up of SOM
- Main driver of sustainability due to nutrient cycling and improved soil / agroecological health
- Almost all of the agronomic problems we face (weeds, diseases, insects, fertility, etc.) can be traced to problems with ecosystem processes.
  - Must recognise the destructive impacts of <u>tillage</u> on soil and water (both on and off site)
    - ... and lack of diversity
- Must compare (the long term costs & benefits) of Diverse Cropping Systems with (the costs & benefits) of controlling Pests, Diseases, Weeds, Fertility, etc.
- Rotations that are <u>not consistent</u> in terms of either interval or sequence provide the best protection against species shifts and biotype resistance.
- Rotations should have crop type to crop type intervals of <u>a minimum of two years</u> somewhere in the rotation.
- Perennial sequences are an excellent way to "jump start" the system.
- The desire to increase diversity and intensity needs to be balanced with profitability.
- YIELDS: doubled with same fertiliser levels, or the same with much less fert; some reports of much higher yields with CC's (due to improved soil health)

# **GRAAN S**

# **Diversified cropping systems**

**SIMPLE ROTATIONS:** Rotations with only one crop of each crop type used in a set sequence. This is the most common type.

EXAMPLES:

- Winter Wheat-Corn-Fallow;
- Wheat-Canola;
- S. Wheat-W. Wheat-Corn-Sunflower;
- Corn-Soybean;
- Winter Wheat-Corn-Pea

# **SIMPLE ROTATIONS WITH PERENNIAL SEQUENCES:** Simple rotations that are diversified by adding a sequence of numerous years of a perennial crop. EXAMPLES:

• M-Sb-M-Sb-M-Sb-Alf-Alf-Alf-Alf and many others



**COMPOUND ROTATIONS**: Combination of two or more simple rotations in sequence to create a longer more diverse system. EXAMPLE:

- S. Wheat W. Wheat Maize Soybean Maize -Soybean.
- This results from a combination of the Maize Soybean and S. Wheat - W. Wheat – Maize - Soybean rotations.



**COMPLEX ROTATIONS:** Rotations where crops within the same crop type vary.

EXAMPLE:

Barley - W. Wheat – Maize - Sunflower – Sorghum - Soybean or Barley – Canola - Wheat-Pea.

This is similar to the example cited for compound rotations. Barley has been substituted for one of the wheat crops; sorghum for one corn; and sunflowers for one soybean.



**STACKED ROTATIONS**: One of the less well-known approaches is one we call stacked rotations. This includes rotations where crops or crops within the same crop type are grown in succession (normally twice) followed by a long break.

- ...the way that plants sequence in nature.
- The theory behind stacked rotations is to provide a long break somewhere in the system.

#### EXAMPLE:

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- Wheat Wheat Maize Maize Sb Sb;
- Barley Wheat Pea Canola

#### **Cover crops**

- Requires a major change in philosophy and practice
  - Treat it as cash crop, it does pay
- Multiple roles and functions
- <u>NB</u>: Crop diversity (above-ground) = diversity of 'active live roots' = feed a diversity of MOs (below-ground) = accelerate increase in SOM = healthy soils = more soil water, higher fertility, less compaction, etc.
- Catch and release of nutrients (catch crops)
- Cover crop 'cocktail mixtures' of 6-12 crops to get diversity
- Diversity speeds-up biological time
- Mimicking nature (i.e. prairies)
- Higher organic Nutrients, less inorganic Nutrients much more stable source



#### **Minimising soil disturbance**

- Move from single- & double discs to 'scissors'
  - 'Keaton-finger' to press seed into furrow
- Best planter is buffalo Use livestock as 'tillage':
  - 1<sup>st</sup> buffalo press seed into soil
  - 2<sup>nd</sup> buffalo cover seed
  - 3<sup>rd</sup> buffalo fertilise
- Disturbance of tine planters = weeds(minus soil water) & disruption of soilstructure





#### Weed management

**Best weed control** is good crop canopy, soil cover and minimal disturbance = 97% weed control Must be cleverer than your enemy Glyphosate: 2 events per year (Canada) to once every 5 years **USA** 

# Integrated crop-livestock systems

- Livestock improves nutrient cycling and soil health (if done properly)
- Multi-specie pastures or cover crops – up to 20 species in rotation with cash crops
- Pasture (fogage) better than hay; leaving animals on field leaves more nutrients on land, also higher C sequestration
- "Rumens as portable soils"
- Livestock kraaled in crop fields -C fertilisation - add legumes to Maize as intercrop (silage)





#### Integrated crop-livestock systems

- Roles of livestock: nutrient distribution, weed control, disease control, pest control, stubble management
- Need to manage competition for biomass (soil vs animals)

#### **CA and Smallholders**

If solutions depend on resources of which we do not have enough access to, then they are not real solutions

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- External inputs expensive and can usually not be sustained
- Making agricultural inputs more accessible to smallholders may be necessary – in some cases – but only one of many solutions;
- Smallholder farmers do not reason in terms of crops or cropping systems, they make decisions that concern their whole livelihood system;
- Free handouts distort adoption of CA and act as counter attractions
- Agricultural inputs do not work on degraded soils; soil rehabilitation is a prerequisite for any form of agricultural intensification
- Smallholder CA is transforming farming in Africa through <u>LEISA</u>

GRAIN SA GRAAN SA

Limited promotion methods compromise adoption -- Innovation Systems / Farmer Field Schools good options.



#### **Agricultural Innovation System**





Grain SA / Maize Trust: CA-Farmer Innovation Programme Key Strategic Objectives (KSO's)



Awareness & Access to Info

Education and Training Farmer-centred Innovation System

(Farmer Innovation Platforms)

> On-farm, farmer-led Research

Incentive and Market Based Mechanisms







Farmers are Compulsive Innovators...

'Everything we do for (preferably 'with') farmers, will only be sustainable and successful to the extent that we **respect**, **accept** and **use** farmers as innovators'

= EMPOWERMENT

Natural and economic sciences play key complimentary role







- The Winter Cereal Trust
- The Maize Trust



#### **THANK YOU**

#### "Take care of the land and the land will take care of you"

Hugh Hammond Bennett, 1950



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