Conservation Agriculture and its Role in Soil Health, Sustainable Food Production and Food Security.

A topical lunch on October 4th 2010 was held on the above topic. After introductions, Peter Hobbs briefly explained what soil health and conservation agriculture was from an agronomist's point of view. This was followed by a brief description of the CA web site by Lucy Fisher http://conservationagriculture.mannlib.cornell.edu/ Erika Steiger also described her participation at the 5th World Congress on Conservation Agriculture held in Brisbane last week. The topic was then opened for discussion on ways to get a Cornell community more involved in the larger picture of sustainable land management to meet future food security needs.

There were several good comments made during the short discussion. Bernd Blossey felt the topic was too narrow to interest his environmental and larger scale research. But this means that there is a need to develop an umbrella group to encourage synergies between disciplines to better address the future challenges of feeding a population that is way bigger than nature ever intended. Sustainable Land Management will need involvement of soil science, agronomy, plant pathology, natural resource management, ecology, economics, climatology, sociology and other disciplines that we have at Cornell. We also need to link with outside agencies in the USA but also overseas.

Frank DiSalvo suggested that there was a need to leverage resources, one important role for any umbrella group. The CARE project that also has an interest in sustainable land management is an example of an outside linkage that could bring the different disciplines together. There was no time to discuss who would take the lead in finding such type of funding sources. Maybe a small working group could be formed for this purpose.

Bianca Moebius made a good suggestion after the meeting "to bring in people (in-house or from elsewhere) to explicitly address the differences in methods, vocabulary, scopes of interest, goals, mind-frames, etc, and invite a lot of discussion to move forward meaningfully." This could be done through well planned meetings where various campus groups are invited to get together and discuss issues of Sustainable Land management (SLM) including soil health, invasive species, waste management, water resources, SRI, EcoAgriculture and other interested groups.

The attendees at this meeting were:
Host Peter Hobbs, ph14 CSS and International Programs, CALS
Lucy Fisher, lhf2 CIIFAD and SRI program
Chris Barrett, cbb2 AEM
Bernd Blossey, bb22 NTRES
Janice Thies, janice.thies@cornell.edu CSS
Bianca Moebius-Clune, bnm5 CSS
Eugene Fifer, etf26 IARD MPS student
Erika Styger, eds8 CIIFAD and SRI
Frank DiSalvo, fjd3 Director Atkinson Center
Alex Travis, ajt32 Institute of Animal Health
Harold Van Es, hmv1 CSS
Champat Raj Mehta, crm236 Visiting scientist from India in CSS
David Lee, drl5 AEM
Helene Schember, hrs6 Executive Director Atkinson Center
Todd Schmit, tms1 AEM
Julie Lauren, jgl5 CSS

John Duxbury, jmd17 CSS
Emily Reiss, err76 Graduate Student Horticulture
Devon Jenkins, devonjenkins@gmail.com IARD MPS student
Meth Anne Medvecky, bam44 CIIFAD IGERT program
Mark Lawrence, mal64 Atkinson Center
Amod Thakur amod_wtcer@yahoo.com Borlaug Fellow from India
Ramana Rao Kondapally kvramanarao@yahoo.com Borlaug Fellow from India
Brian Sobol bds229 Graduate student Horticulture
Charles Hyland cph22 Research assistant CSS

Future Agricultural Challenges

- To increase food production sustainably to meet food security needs of a growing population now and in the future while at the same time minimizing the effects on the environment and improving the livelihoods of those involved in agriculture
- Improve the efficiency of natural resource use needed for agriculture through Sustainable Land management

WHEN

Business as usual will not get the job done.

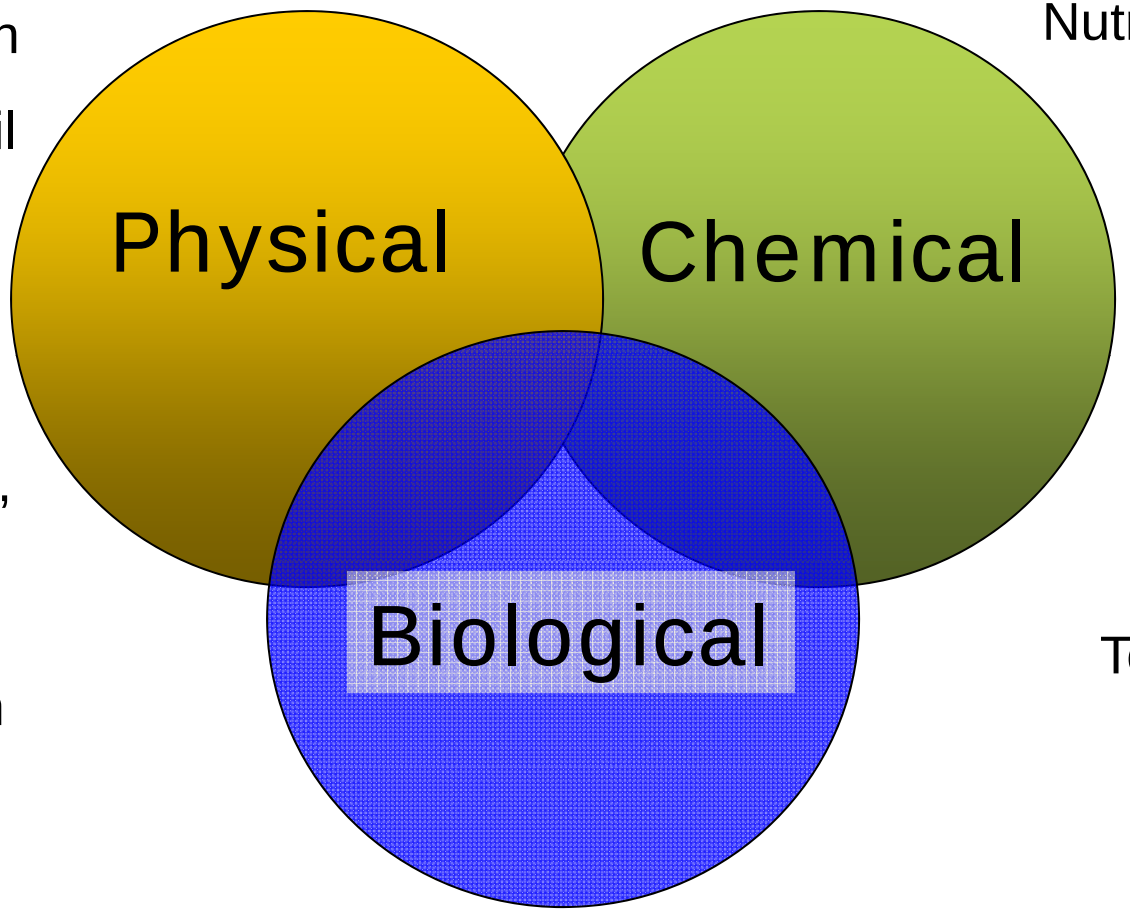
- Demand for food – ***increasing – areas with food insecurity***
- Harvested area per capita - ***shrinking***
- Traditional sources of productivity growth – are **already being used*?***
- ***Competition and demands*** for blue water increasing
- Future oil price **increases** and costs of inputs
- Impending **climate change** and more ***severe weather*** as a result of GHG emissions and global climate change
- ***There is resource, environmental and land degradation?***
- ***Dietary changes***
- ***Biofuel competing for agricultural land***

Soil Health a Key Agronomic component

An Unhealthy Soil

A Healthy Soil

Soil Health – Soil Function



Root proliferation

Movement of soil organisms

Aeration

Water retention

Water infiltration, filtration and transmission

Stability: erosion prevention

Nutrient content, retention & release

pH

Redox

Energy (C) storage

Toxicity mitigation

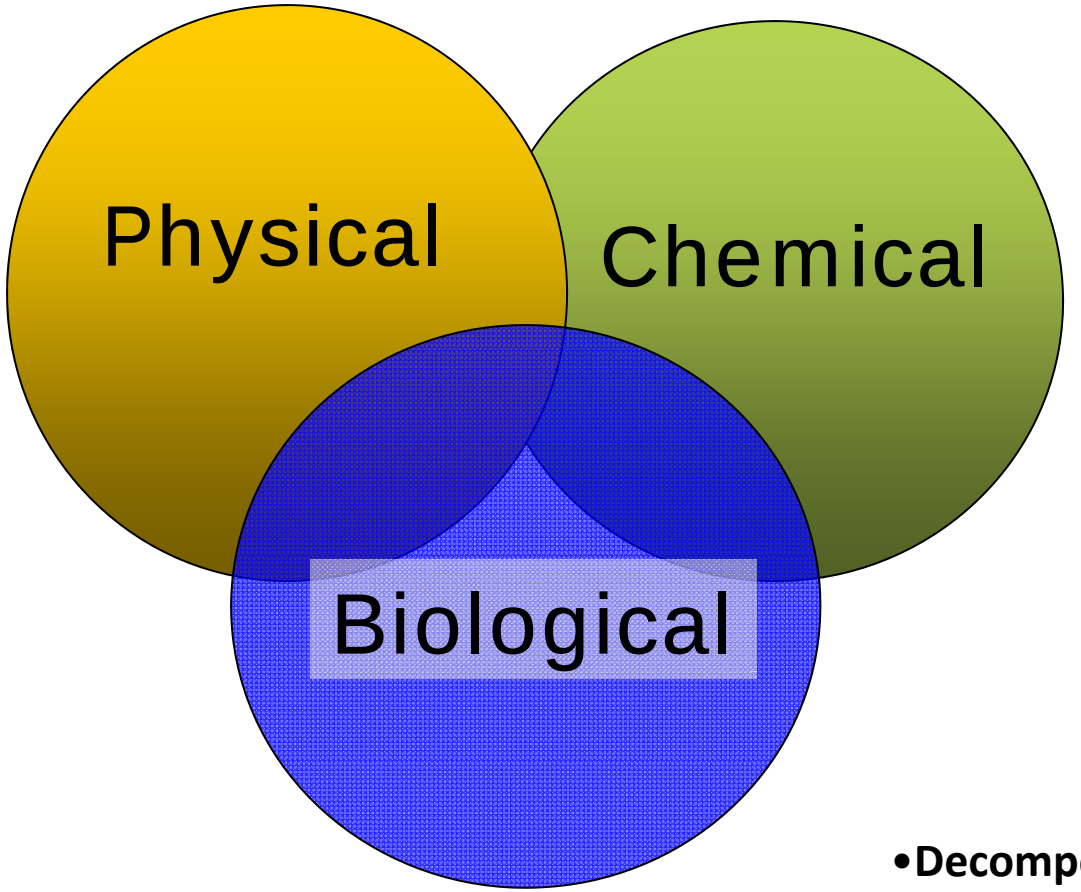
Nutrient cycling OM decomposition N_2 fixation

Cause/suppress disease Consume/release GH gases

Bioremediate contaminants Genetic reservoir

Soil Health – Indicators

- Bulk density
- Penetration resistance
- Aggregate stability
- Water infiltration rate
- Water holding capacity
- Pore size distribution



- % OM
- "Active" C, N in OM
- Cation exchange capacity
- N, P, K
- Micronutrients
- [Toxins, pollutants

- Soil disease suppressive capacity
- Beneficial and pathogenic nematodes, [other pathogens]
- N mineralization rate (PMN)

- Decomposition rate
- microbial biomass
- Respiration rate
- Earthworm counts
- Genetic diversity

Degraded soil ⟷ Healthy soil

Low organic matter	Higher organic matter
Poor physical properties	Improved physical properties
Poor water infiltration	Improved water infiltration
Poor nutrient cycling	Improved nutrient cycling
Declining productivity	Sustainable production
More pathogens	Less pathogens
Nutrient deficiencies	Balanced fertility
Low biological diversity	Good biological diversity

Intensively mined agricultural soil
No organic amendments

Forest soil – not disturbed
Leaf mulch

Degraded soil ⟷ Healthy soil

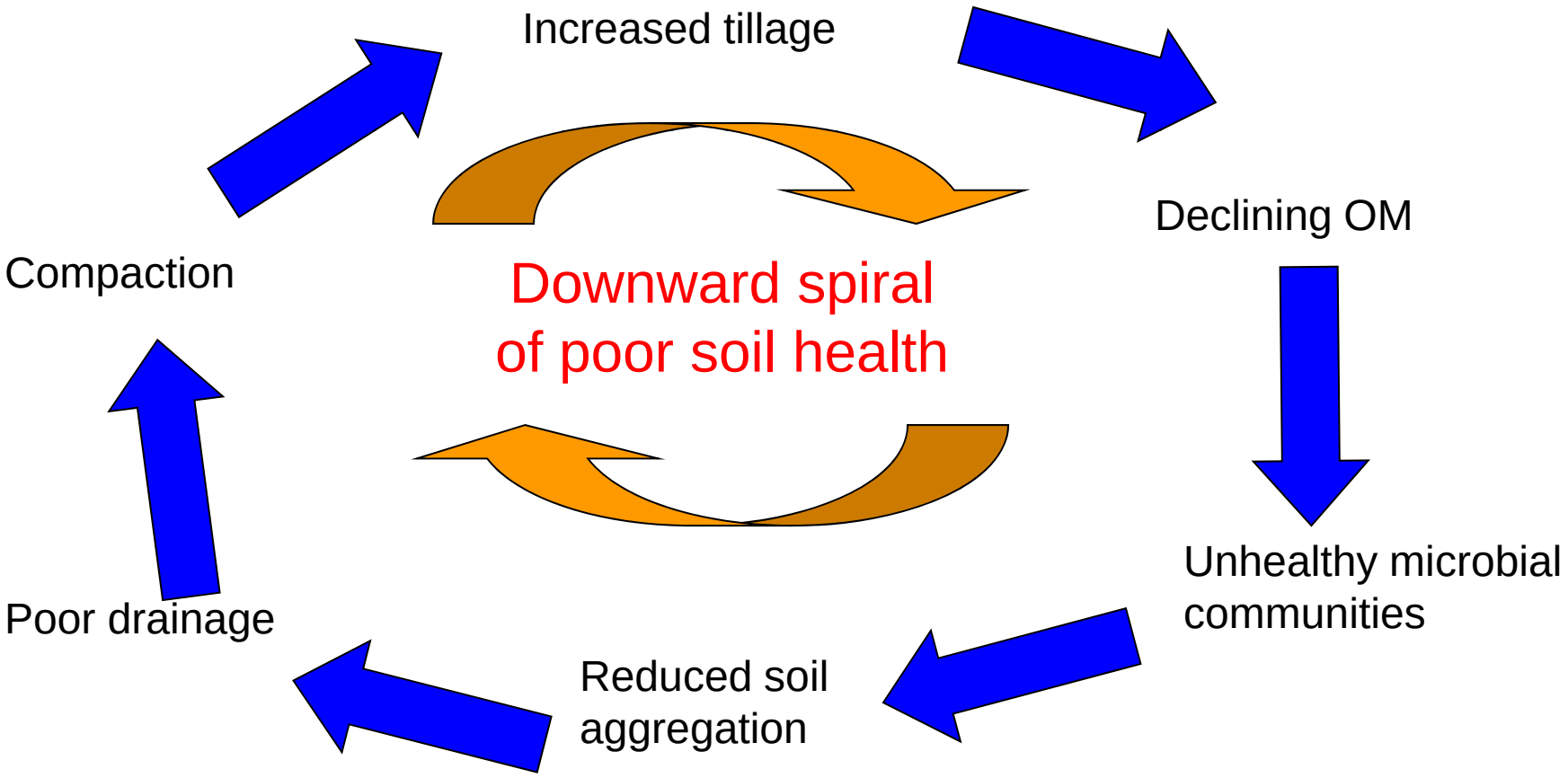
No addition of organic matter
Only use chemical fertilizer
Excessive tillage
Use of toxic pesticides
Mining of soil nutrients by unbalanced fertilizer use
Erosion – wind or water

Use of organic amendments
Minimal soil disturbance
Use of surface mulching
Use IPM, IWM, IDM, ICM
Rotations
Nutrient balancing

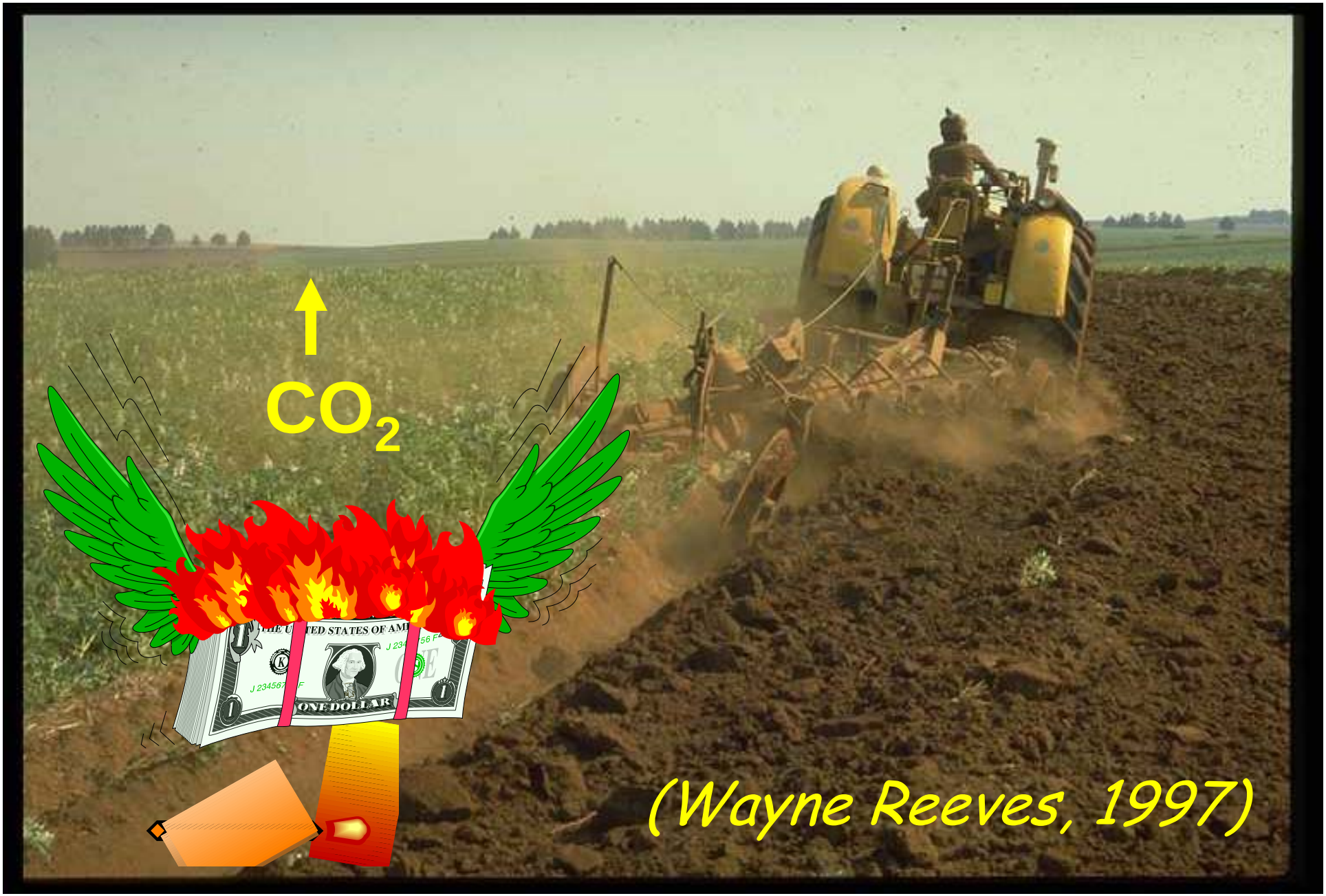
Present farming practices??

Sustainable Land Management like Conservation Agriculture or Resource Conserving Technologies

Tillage Addiction: Downward Spiral in Soil Health



Is tillage necessary?



Conservation agriculture?

- Minimal soil disturbance – zero-tillage if possible – just enough to get the seed in the ground
- Permanent soil cover – residues of past crop or cover crop grown to provide cover. NO burning of residues
- Rotations – mainly for residue pest, disease, weed control
  - But still need to use integrated practices for weed, pest and disease control
- Can be on the flat or on raised beds


Residue retention distinguishes Conservation Agriculture from conventional farming systems, which are characterized by leaving the soil bare and unprotected, exposed to climatic agents.
The plant cover is not incorporated into the soil by tillage.
Conservation agriculture is different from conservation tillage in that soil disturbance is minimal
(FAO, 2002)

CA is applicable to all farm sizes

No-tillage on big farms with tractors

No-tillage for animal traction

No-tillage in manually operated farms


Basal Dressing

“There are a lot of changes necessary to adopt zero tillage (and conservation agriculture) but the biggest change is in the mind.”

Franke Dijkstra

Pioneer Brazilian zero tillage farmer. Started 26 years ago.

CA web site

http://conservationagriculture.mannlib.cornell.edu/

Atkinson Center Grant

- Continue to develop, add to and improve the CA web site
- To organize an umbrella group at Cornell to promote interdisciplinary research, scholarly dialogue, and international knowledge-sharing related to *Sustainable Land Management* of which conservation agriculture is one management system.