The importance of building resilient farms in response to climate change

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International Federation of Organic Agriculture Movements

OKAHANDJA COUNTRY LODGE, NAMIBIA, August 2013

IFOAM is the international umbrella organization for organic agriculture

International Federation of Organic Agriculture Movements

Mission

Leading, uniting and assisting the organic movement in its full diversity.

Goal

The worldwide adoption of ecologically, socially and economically sound systems that are based on the principles of Organic Agriculture.

People

The global organic umbrella organization has over 800 member organizations in around 120 countries.

1.8 million certified organic farmers and substantially more uncertified organic farmers

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The Definition of Organic Agriculture

'Organic agriculture is a production system that sustains the health of soils, ecosystems and people.

It relies on ***ecological processes, biodiversity and cycles adapted to local conditions,*** *rather than the use of inputs with adverse effects.*

Organic agriculture ***combines tradition, innovation and science*** *to benefit the shared environment and promote fair relationships and a good quality of life for all involved.'*

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The Four Principles of Organic Agriculture

Organic agriculture is based on:

- The principle of health
- The principle of ecology
- The principle of fairness
- The principle of care

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IFOAM regards all forms of agriculture that are based on the 4 principles and the definition as ‘organic’.

These can include:

- Agro-ecology, Eco Agriculture, Bio, Ecological Agriculture, Natural Farming, Biological Agriculture, Permaculture, Biodynamic Agriculture, Agroforestry and other ecological based systems

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Food Security

- World food production is already being effected by climate change

- More frequent and longer droughts
- Irregular rainfall that tends to be heavy and destructive
- Supplying adequate food is vital for the whole world

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Organic Matter - Benefits

- The term ‘Organic’ in Organic Agriculture was popularised in the 1940s and comes from the recycling of organic matter as one of the primary management systems
- Composting, mulching, green manures, cover crops etc
- Increasing organic matter in farming systems brings multiple benefits

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Organic Higher Yields in Climate Extremes

- **Organic systems have higher yields** than conventional farming systems in weather extremes such as heavy rains and droughts. (Drinkwater, Wagoner and Sarrantonio 1998; Welsh, 1999; Lotter 2004)
- The Wisconsin Integrated Cropping Systems Trials found that organic yields were higher in drought years and the same as conventional in normal weather years. *(Posner et al. 2008)*
- The Rodale FST showed that the organic systems produced 30 per cent more corn than the conventional system in drought years. *(Pimentel D 2005, La Salle and Hepperly 2008)*

Organic Matter Increases Infiltration

Organic

Conventional

Picture: FiBL DOK Trials

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Soil Organic Carbon Mitigates and Adapts

- Higher corn and soybean yields in drought years
- Increased soil C and N

- Higher water infiltration
- Higher water holding cap
- Higher microbial activity
- Increased stability

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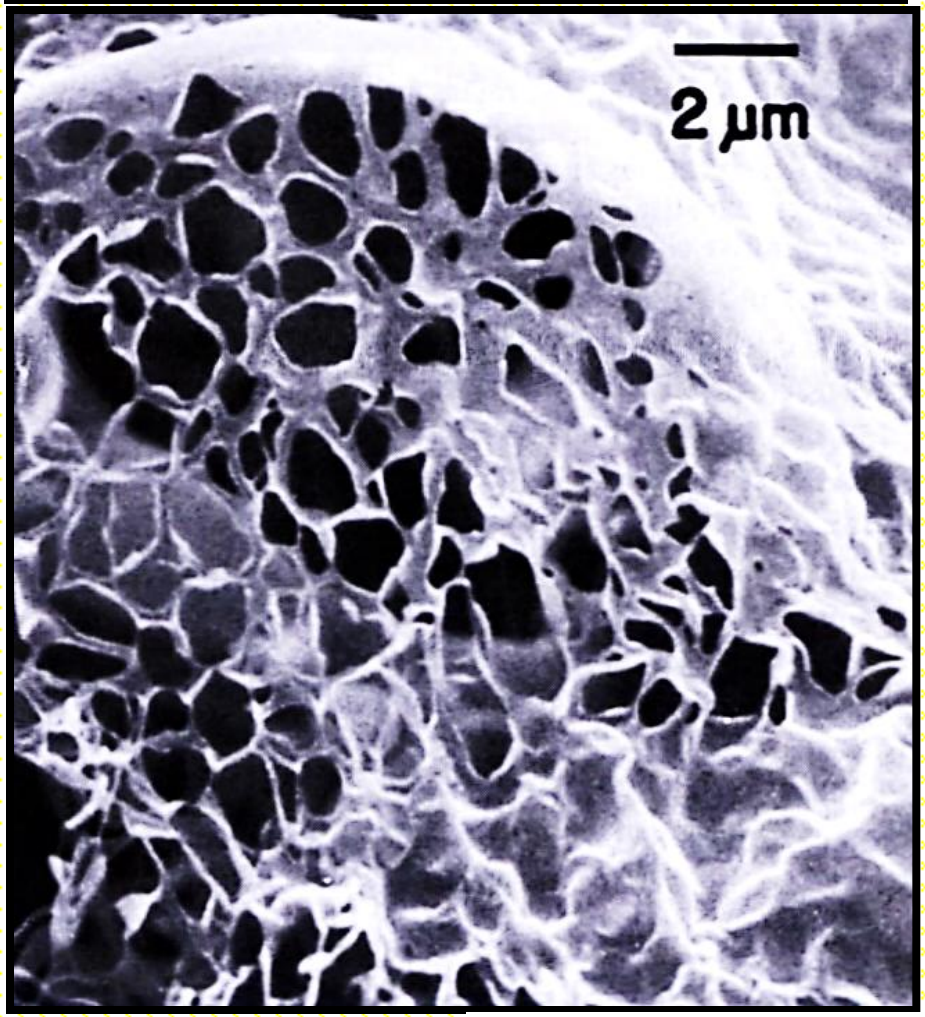
Soil Organic Matter
Living Carbon

- Holds up to 30X its weight in water
- Cements soil particles and reduces soil erosion
- Increases nutrient storage & availability
- Humus can last 2000 years in the soil

Electron micrograph of soil humus



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Soil Organic Matter/Soil Carbon

Research Shows that Organic Systems use Water More Efficiently

- Volume of Water Retained /ha (to 30 cm) in relation to soil organic matter (OM).
- 0.5% OM = 80,000 litres (common conventional level)
- 1 % OM = 160,000 litres (common conventional level)
- 2 % OM = 320,000 litres
- 3 % OM = 480,000 litres
- 4 % OM = 640,000 litres
- 5 % OM = 800,000 litres
- 6 % OM = 960,000 litres

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Organic Corn - 1995 Drought

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High Yield Organic Agriculture

The average corn yields during the drought years were from 28% to 34% higher in the two organic systems.

The yields were 6,938 and 7,235 kg per ha in the organic animal and the organic legume systems, respectively, compared with 5,333 kg per ha in the conventional system (Pimentel, 2005)

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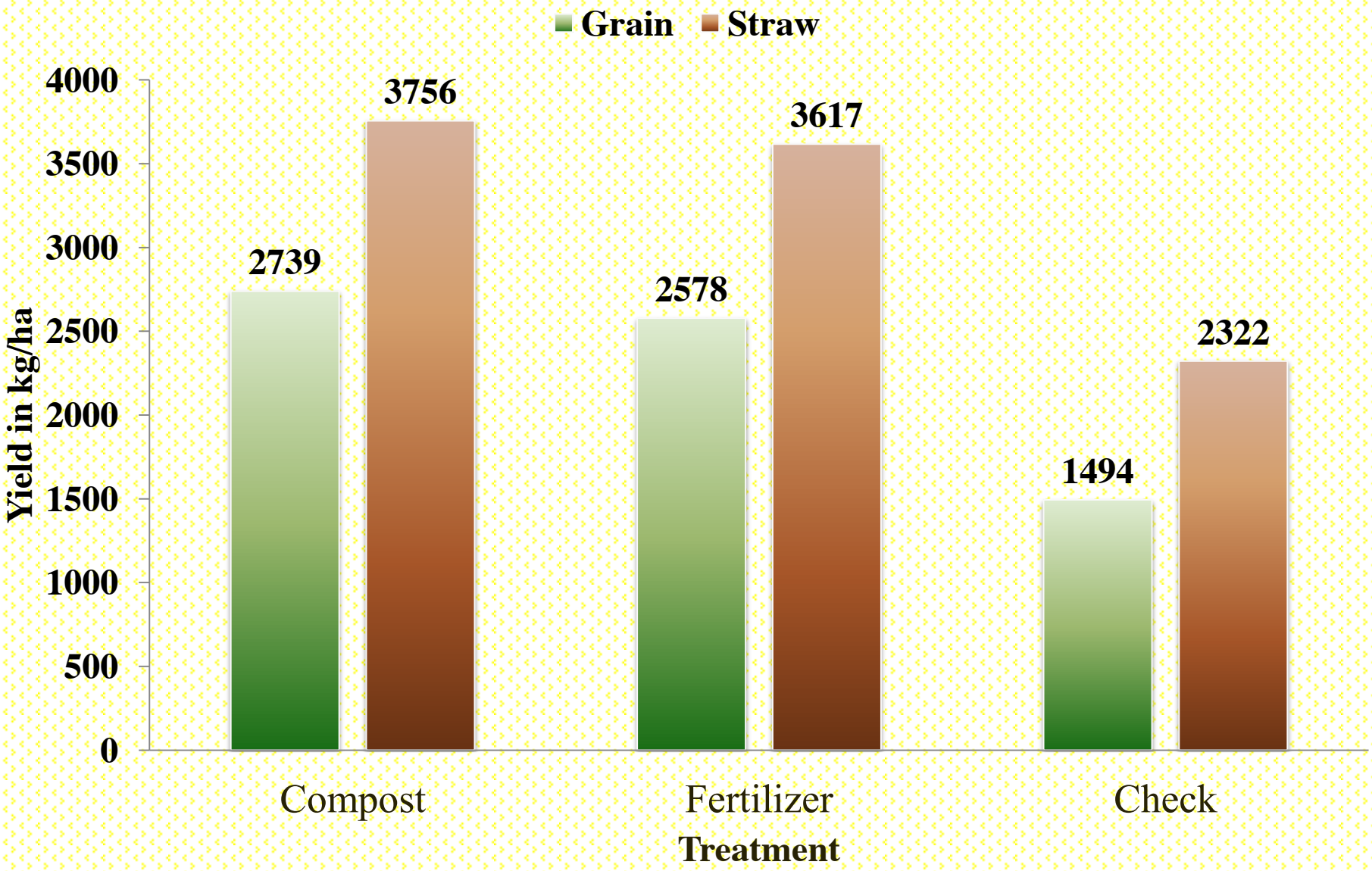
Initial impacts on wheat yields in Hintalo Wejerat, Tigray, 2010



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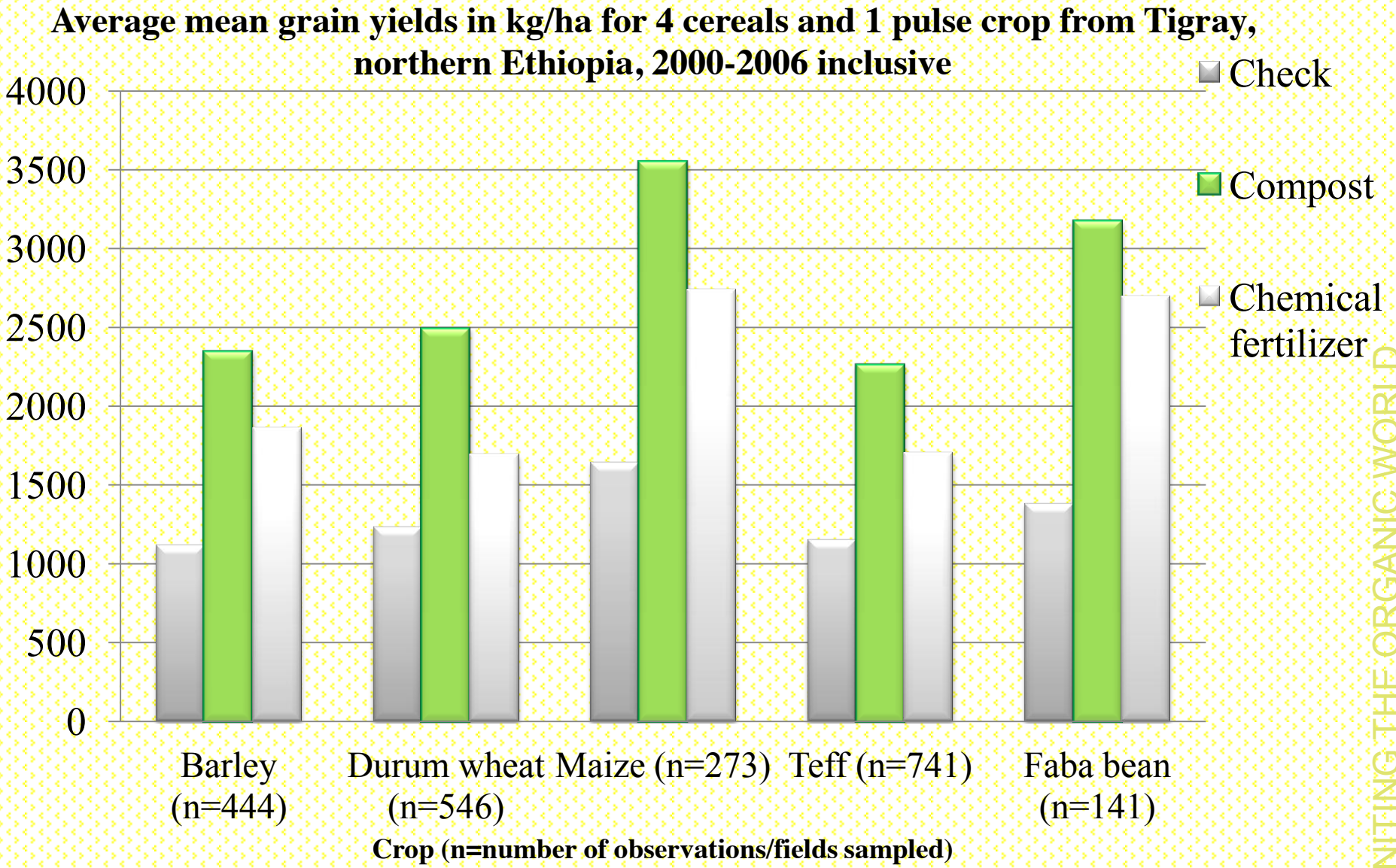
Impact of using compost - Grain yields from over 900 samples from farmers fields over 7 years



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Scientist visiting bread wheat fields

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Wheat infested with stripe rust and sprayed – gave yield of 1.6 t/ha

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Wheat grown on composted soil resist the rust – gave yield over 6.5 t/ha

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Insect damage controlled by improving soil nutrition and organic matter leading to plant health

Healthy plants have a greater ability to beat pests and diseases

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Pasture Cropping – *Conservation Agriculture without Herbicides*

Sheep or cattle graze down the pasture before the crop is planted with modified no-till equipment

Works on the principle that annual plants always grow in perennial pastures

Oats Sown into Pasture

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The Carbon Gift

Between 95 and 98% of plant minerals come from water, carbon dioxide and oxygen.

The remaining 5% come from the soil.

30-60% of the carbon and energy used by plants is deposited into the soil

Plant roots put thousand of tonnes per hectare of organic carbon and bio available minerals into the soil every year.

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The Carbon Gift

These carbon based molecules feed billions of microbes – actinomycetes, bacteria and fungi that are beneficial to plants

Plants roots are an important part of the process of forming top soils and good soil structure.

This means that plants can put more nutrients into the soil than they remove from it.

If the weeds are managed properly, and their residues are allowed to return to the soil, their nutrient removal from the soil is zero.

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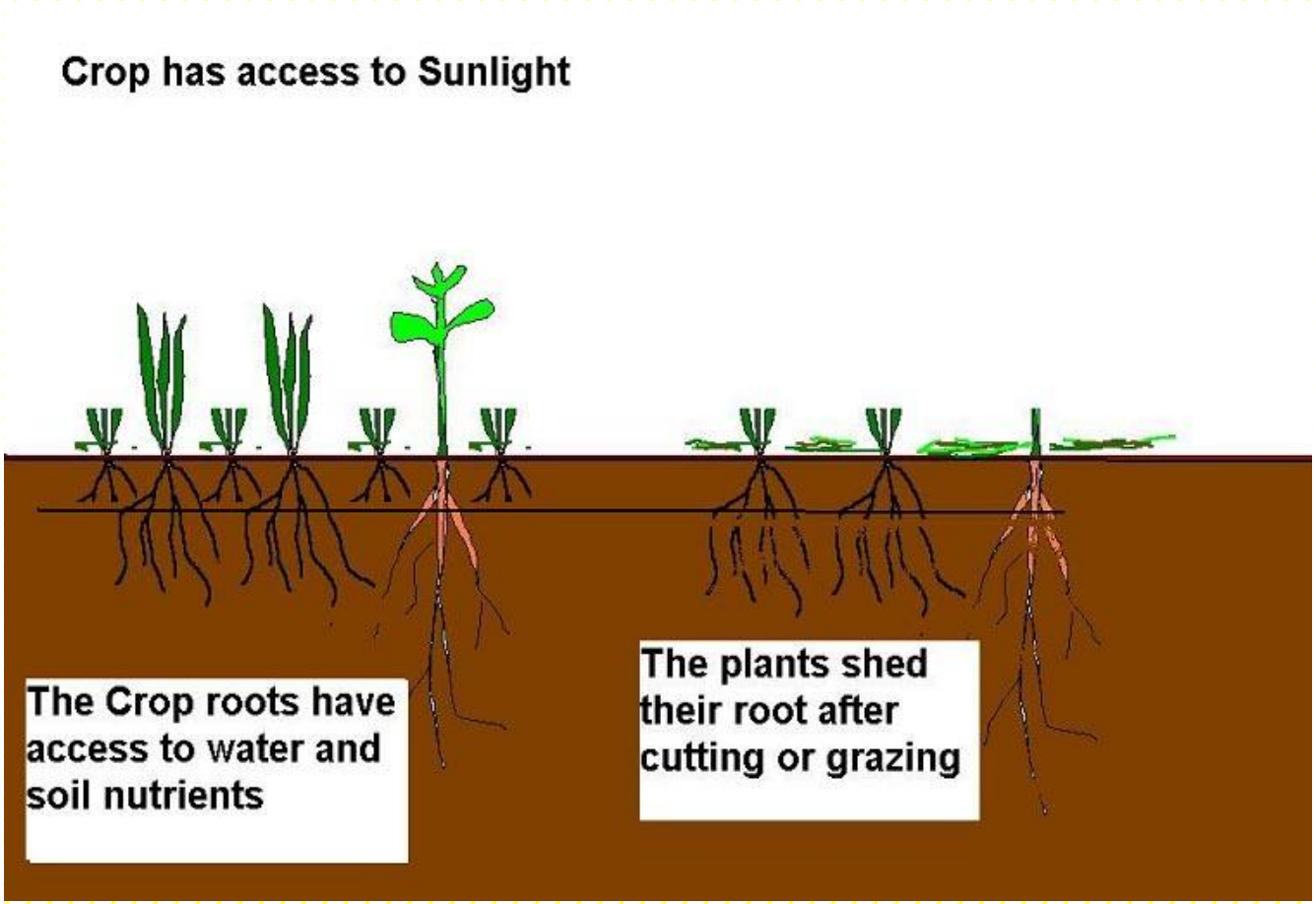
MANAGING GROUND COVERS

- Cutting back plant leaves through grazing and slashing forces plants to shed their root
- Stops weed competition
- for soil nutrients and water
- Stops weed leaf competition for sunlight in cash crop
- Biological activity in soil is stimulated by rootmass activity which feeds microbe communities and generates soil carbon and nutrients for the crop

MANAGING GROUND COVERS



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Pasture Cropping – *Conservation Agriculture without Herbicides*

After 10 years the yields are as high as conventional tillage
The added advantage of a pasture for animal production after the crop

Much lower production, input and energy costs

Significantly higher levels of soil fertility and soil carbon sequestration

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Pasture Cropping – *Conservation Agriculture without Herbicides*

Builds Soil Fertility without Synthetic Fertilisers

The following increases in soil mineral fertility have occurred in 10 years with only the addition of a small amount of phosphorus

•calcium 277%, magnesium 138%, potassium 146%, sulphur 157%, phosphorus 151%, zinc 186%, iron 122%, copper 202%, boron 156%, molybdenum 151%, cobalt 179% and selenium 117%.
(Carbon that Counts: www.ofa.org)

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Pasture Cropping - *Conservation Agriculture without Herbicides*

Soil Comparison between Winona and nearby property. *Picture: Christine Jones*

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Pasture Cropping – *Conservation Agriculture without Herbicides*

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•Dr Christine Jones has conducted research at Colin Sies's property in NSW showing that in the last 10 years 168.5 t/ha of CO_2 was sequestered.

Total Agricultural Land 4,883,697,000ha (FAO, 2010)
Organic @ 16.8 tons per hectare: 82Gt of CO_2
Annual GHG emissions:49 Gt of CO_2e (IPCC Fourth Assessment Report (AR4), 2007)
82Gt per annum = 167% of global GHG emissions

•This increase occurred during the worst drought in recorded Australian history

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Organic Matter - Benefits

- Scientific research shows that the correct management of grazing systems and perennial horticulture increases soil organic matter faster than cropping systems.
- Maintaining maximum soil cover combined with periodic heavy grazing or mowing is the key
- Avoid bare soil as much as possible

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Conservation Agriculture without Herbicides

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Conservation Agriculture without Herbicides

Pictures: Rodale Institute

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High Yield Organic Agriculture without Herbicides

The 2006 trails resulted inorganic yields of 160 bushels and acre (bu/ac)

compared to the County average of 130 bu/ac.

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High Yield Climate Smart Organic Agriculture – lower energy use

The long term Rodale Farming Systems Trial

Energy Used in Different Corn Production Systems
Expressed in Litres of Diesel per Hectare

Conventional Tillage:	231 litres per hectare
Conventional No-till:	199 litres per hectare
Organic Tillage:	121 litres per hectare
Organic No-till:	77 litres per hectare

(Pimentel D et al 2005)

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The Rodale Farm Systems Trial

The legume based organic plots showed that carbon was sequestered into the soil at the rate of about 500 lbs/ac/year. This is equivalent to a sequestration rate of 2,055.2kg of CO_2/ha/yr.

The manured organic plots showed that carbon was sequestered into the soil at the rate of 875 lbs/ac/year. This is equivalent to a sequestration rate of 3,596.6 kg of CO_2/ha/yr.

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High Yield Climate Smart Organic Agriculture – High Sequestration

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The Rodale Farm Systems Trial

The Compost Utilization Trial; showed that carbon was sequestered into the soil at the rate of 2,000 lbs/ac/year. This is equivalent to a sequestration rate of 8,220.8 kg of CO_2/ha/yr.

Total Agricultural Land 4,883,697,000ha (FAO, 2010)
Organic @ 8.2 tons per hectare: 40 Gt of CO2
Annual GHG emissions:49 Gt of CO2e (IPCC Fourth Assessment Report (AR4), 2007)

40Gt per annum = 81% of global GHG emissions

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Eco-function Intensification

- Eco-functional intensification (EFI) optimizes the performance of ecosystem services by utilizing functional biodiversity.
- It is used in organic agriculture to utilize ecological processes rather than chemical intensification.
- Eco-functional intensification is about utilizing the disciplines of applied ***agroecology and permaculture*** to actively increase the biodiversity in agricultural systems to deliver ecosystem services
- Rather than using the conventional approach, based on reductionist monocultures reliant on externally sourced toxic synthetic inputs.

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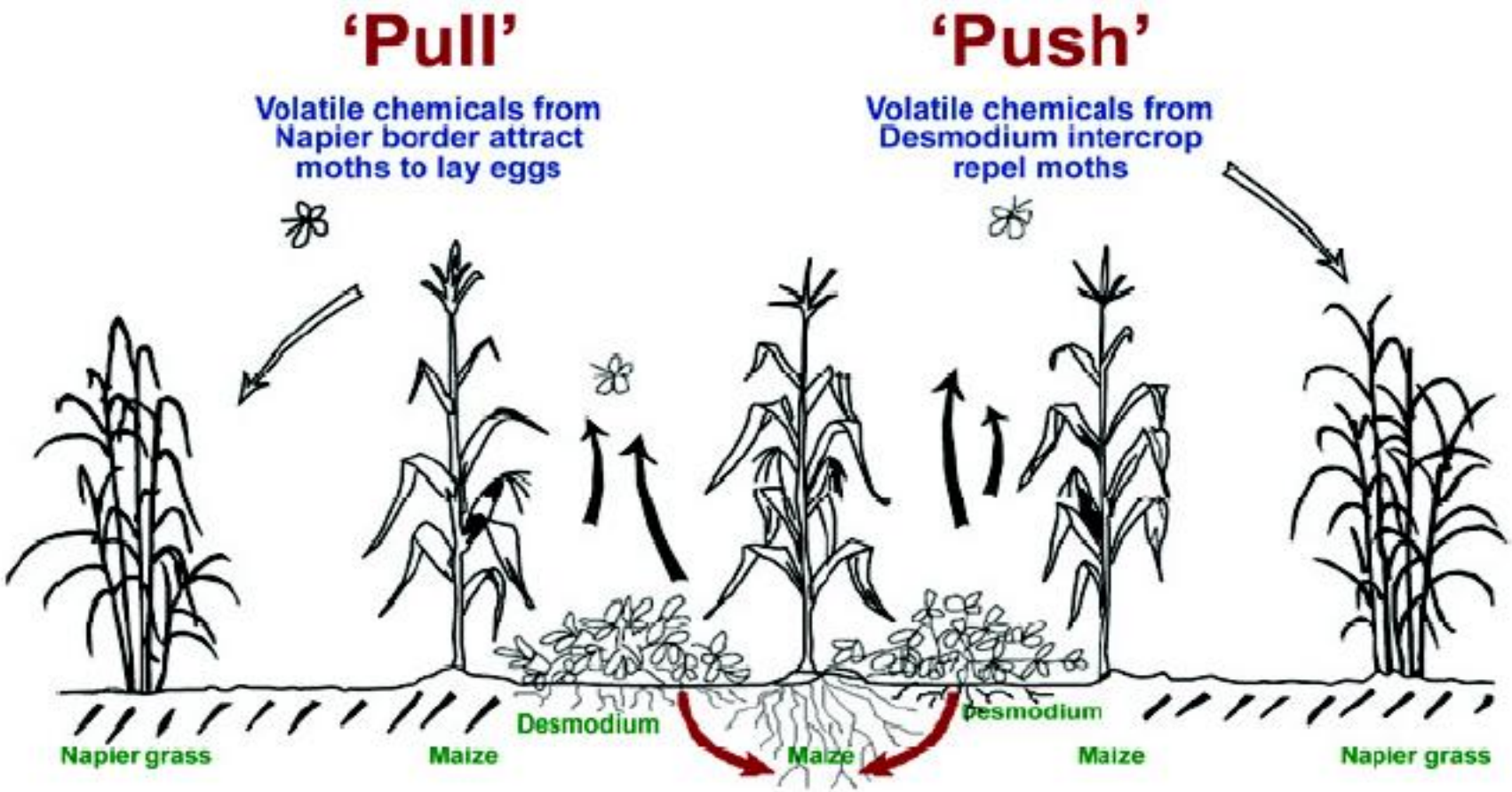
“Push – Pull” for Stemborer and Striga Control



Chemicals (isoflavones) secreted by desmodium roots inhibit attachment of striga to maize roots and cause suicidal germination of striga seed in soil

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Eco Function Intensification
A whole of System's Approach

Using natural systems to regulate pest outbreaks

push-pull
greater farm productivity with higher corns yields (2 to 10X)

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Eco Function Intensification

The Napier grass is progressively cut and fed to a cow. The excess fresh milk is sold everyday as a cash income

Eco Function Intensification

The desmodium, suppresses weeds, adds nitrogen, conserves the soil, repels pests and provides high protein stock feed

INSECTARIES

- Refuges of flowering plants are known as insectaries
- Many beneficial insects have a range of host plants
- Some useful species such as parasitic wasps, Hoverflies and Lacewings have carnivorous larvae that eat pests however the adult stages live mostly on nectar and pollen from flowers

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INSECTARIES

- Flowers provide beneficial insects with concentrated forms of food (pollen and nectar), increase their chances of surviving, immigrating and staying in the area.

- Very importantly flowers also provide mating sites for beneficials, allowing them to increase in numbers

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INSECTARIES

Flowering plants are encouraged to grow throughout the fields and along the borders

Nectar and pollen are essential to the adult stage of many beneficial predators

Research has shown that they breed thousands of beneficial organisms

Tall flowering plant host more species than short mowed or bare areas

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Living Mulch as Insectaries

Flowers attract beneficials, suppresses weeds, conserves water, build soil, increases N and organic matter

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INSECTARIES

Flowering plants with grapes at UC Davis, USA

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INSECTARIES

Different Insectary Models

Perimeter planting
acts as barrier for pests
an windbreak

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Eco-intensification

Insectaries

Borders of flowers create refuges for beneficial insects

Eco-intensification, Agroecology Permaculture

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Insectaries

Borders of flowers, trees and shrubs create refuges for beneficial insects, birds, lizards, frogs etc.
Small birds eat an enormous amount of insect pests and need shrubs and

Provide forage for livestock

Provide biomass for compost

Marginal areas planted with a high diversity of eco functional species, Bhutan

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Eco-function intensification

Maximises solar capture

Does not compete for sunlight

Fixes nitrogen and soil carbon

Green Manure

Flowers attract beneficial Insects

Conserves water and soil

Legume vines in fruit trees. Example of good practice and not a neglected orchard

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Eco-function intensification

Maximises solar capture

Does not compete for sunlight

Fixes nitrogen and soil carbon

Green Manure

Flowers attract beneficial Insects

Conserves water and soil

This is an example of good practice in weed management and not a neglected orchard

Minimal solar capture

Not Eco-function intensification

No Fix of nitrogen and soil carbon

No Green Manure

No Flowers to attract beneficial Insects

Does not conserve water

Soil subject to wind and water erosion

This is an example of worst practice in weed management

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Thank You

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