Mechanization for Conservation Agriculture and its Significance for Carbon Neutrality

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Conservation Agriculture

No mechanical soil disturbance by – seeding or planting directly into untilled soil=**NO-TILL**

Enhance and maintain organic matter cover on the soil surface – using crop residues and cover crops to protect and feed soil life

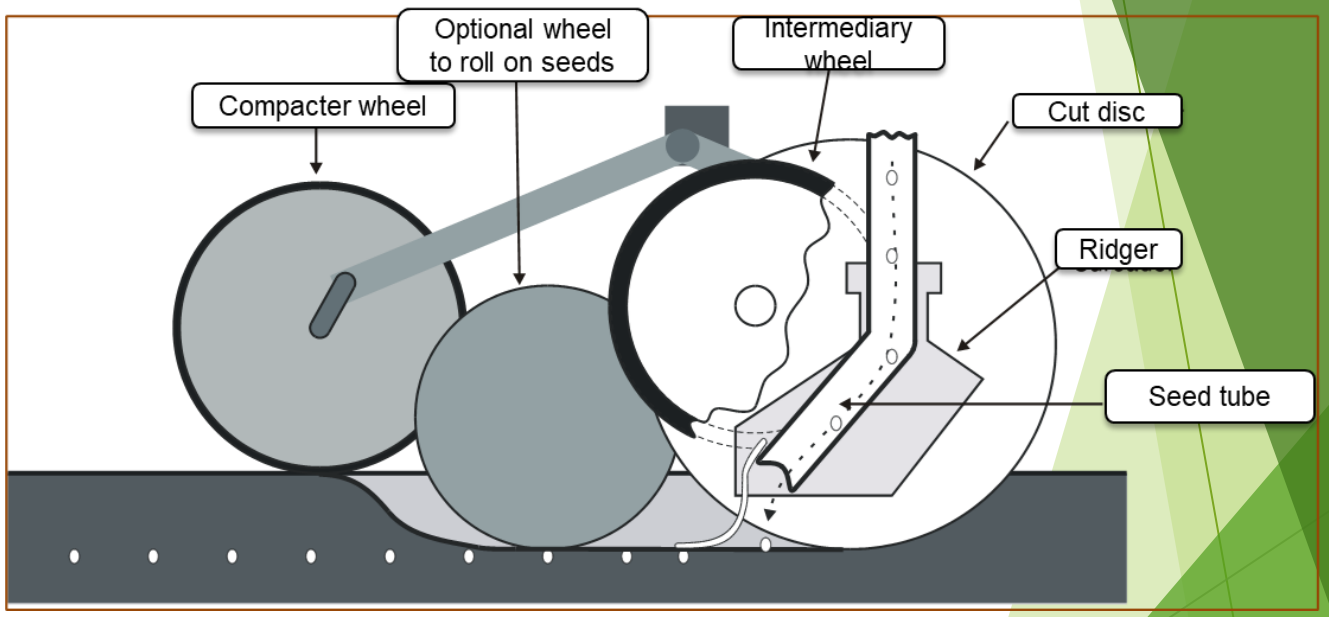
Diversification of species – both annuals and perennials - in associations, sequences and rotations

Key element*: *Conservation Agriculture *is a combination of several resource conserving practices* ***simultaneously*** *creating* ***synergies*** *between them for optimization & sustainability.*

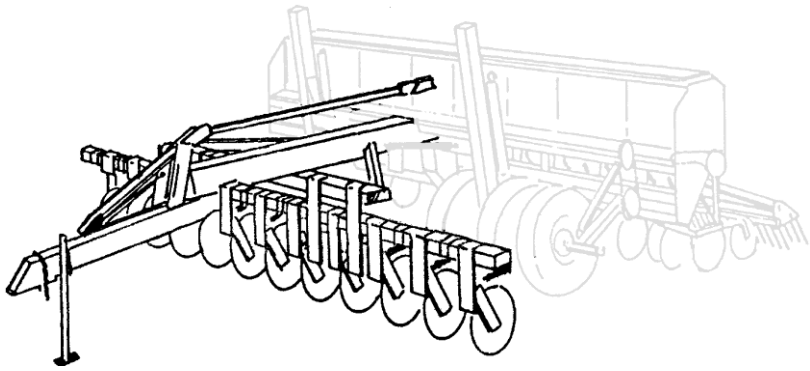
No-till Machinery

- No-till/Direct seed drill may:
  - *Cut stubble*
  - *Place seed in soil properly*
  - *Place fertilizer and/or insecticide properly*
  - *Cover the sedes and get a good soil-seed contact*
  - *Guarantee a uniform seeding depth*
  - *Be heavy enough to cut stubble and to get inside the soil*
  - *Adapt to field conditions and to seeding speed*
  - *Sequester carbon in the soil*

Direct Seeding Machinery



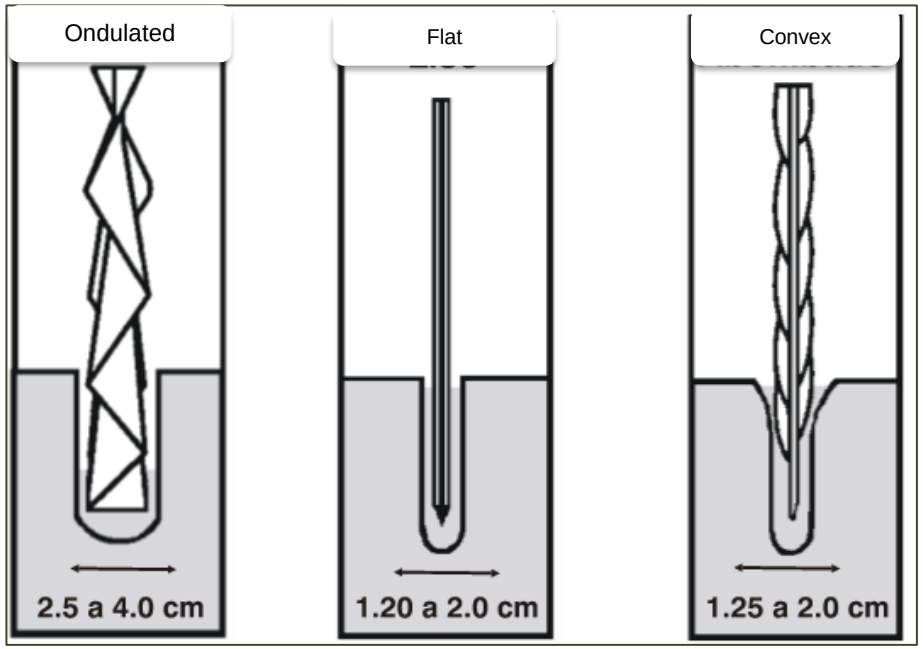
- Cut disc
- Opener disc
- Seed tuve
- Depth controller wheel
- Compacter wheel
- Fertilizer and insecticide gadgets



Seeder weight

- Conservation Agriculture seeders must be heavier than the conventional ones to be able to cut stubble
- Breaking capacity is related to seeder weight and setting of springs
- Seeders have pressure springs that:
  - *Push the sowing unit to the soil and*
  - *Allow a uniform sowing depth*
- The heavier part is the chassis to which cut discs are joined

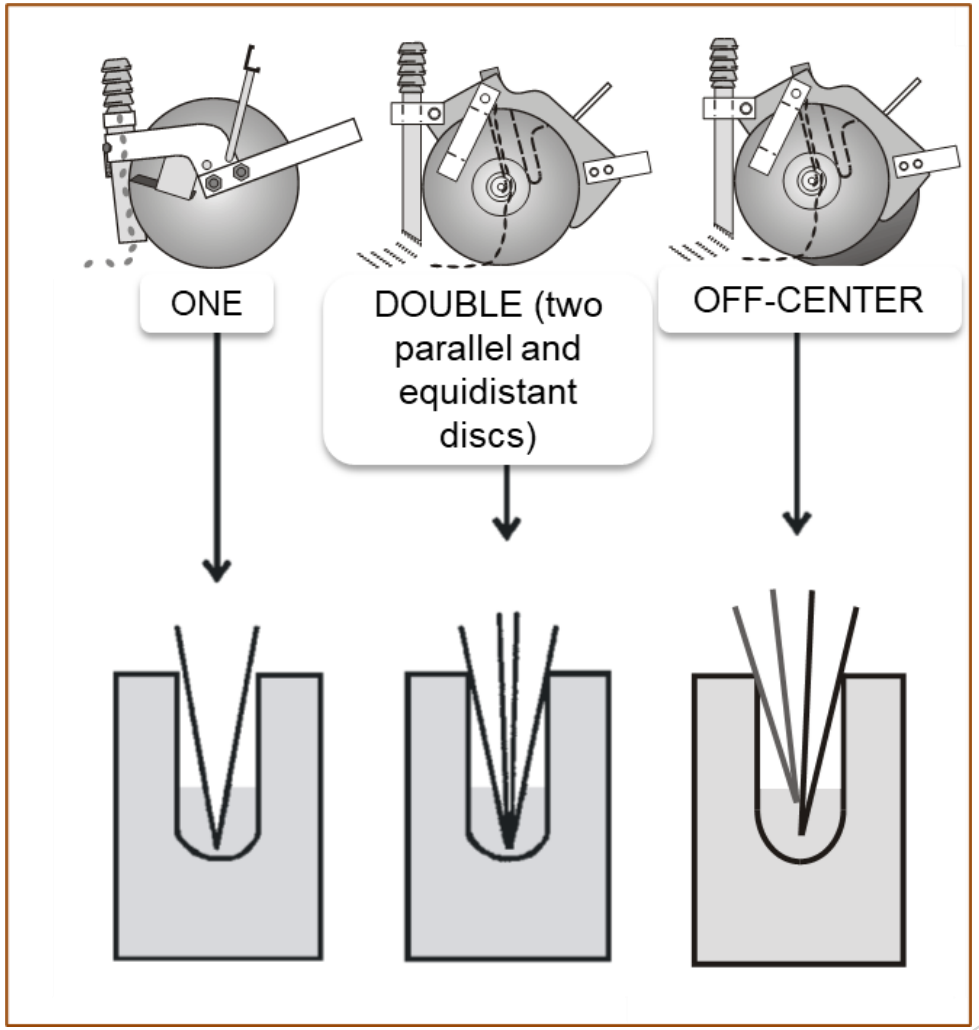
Cutting discs



- They cut stubble and facilitate the opener discs function
- They are located opposite to opener discs
- They work 2 to 3 cm deeper than opener discs
- They open the furrow, then the opener discs “plow a little” to favor the seed germination and the crop implantation
- They have to:
  - *Cut stubble and open an opening*
  - *Move some stubbles*
  - *Plow a narrow strip*
- Cut discs types
  - *Ondulated or striated*
  - *With flat or straight edge*
  - *convex*

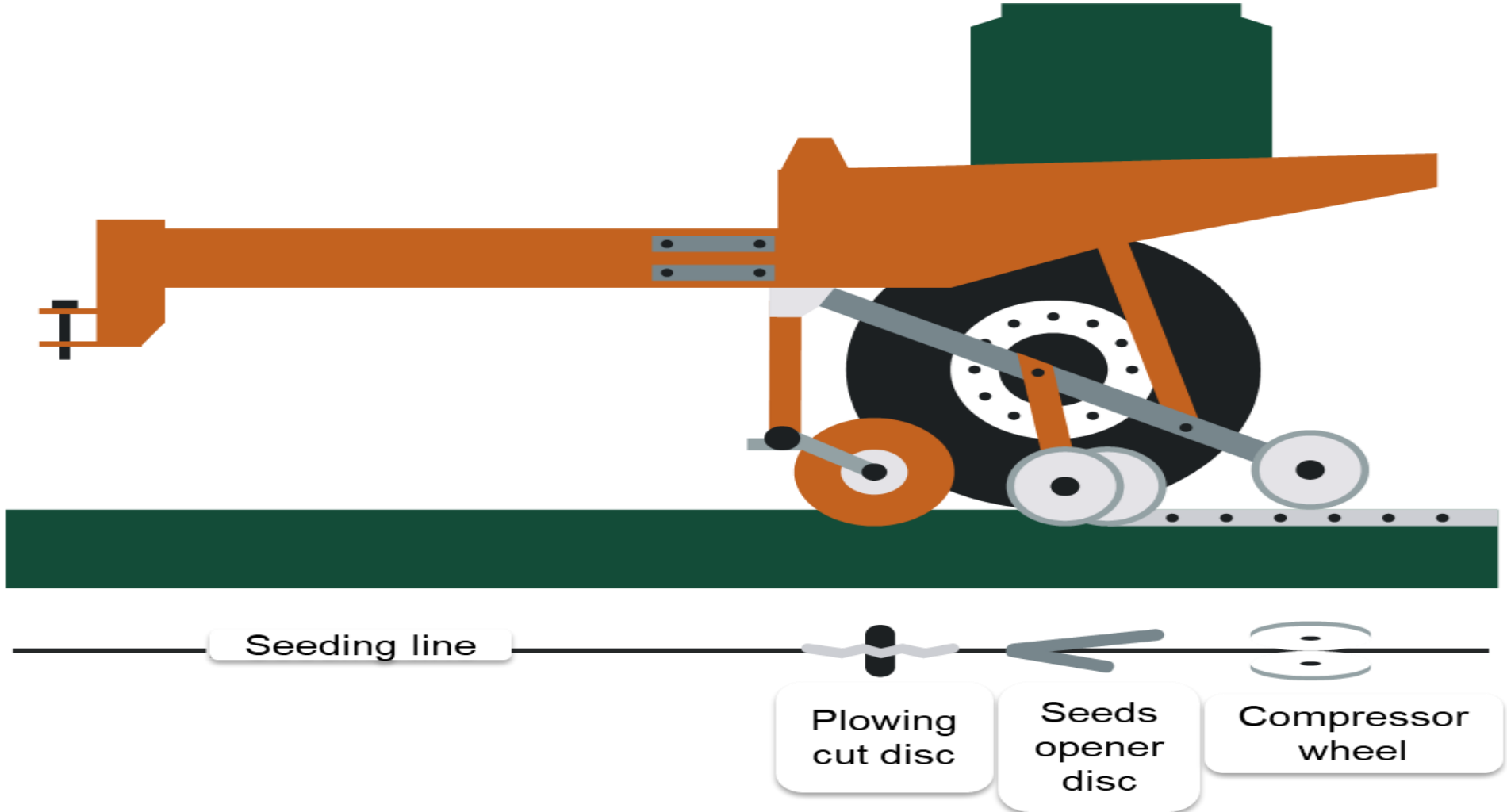
Opener discs

- They open and prepare the furrow
- They have a tube to place the seed in the soil
- Types:
  - *One disc*
  - *Double disc*
  - *Off-center disc*



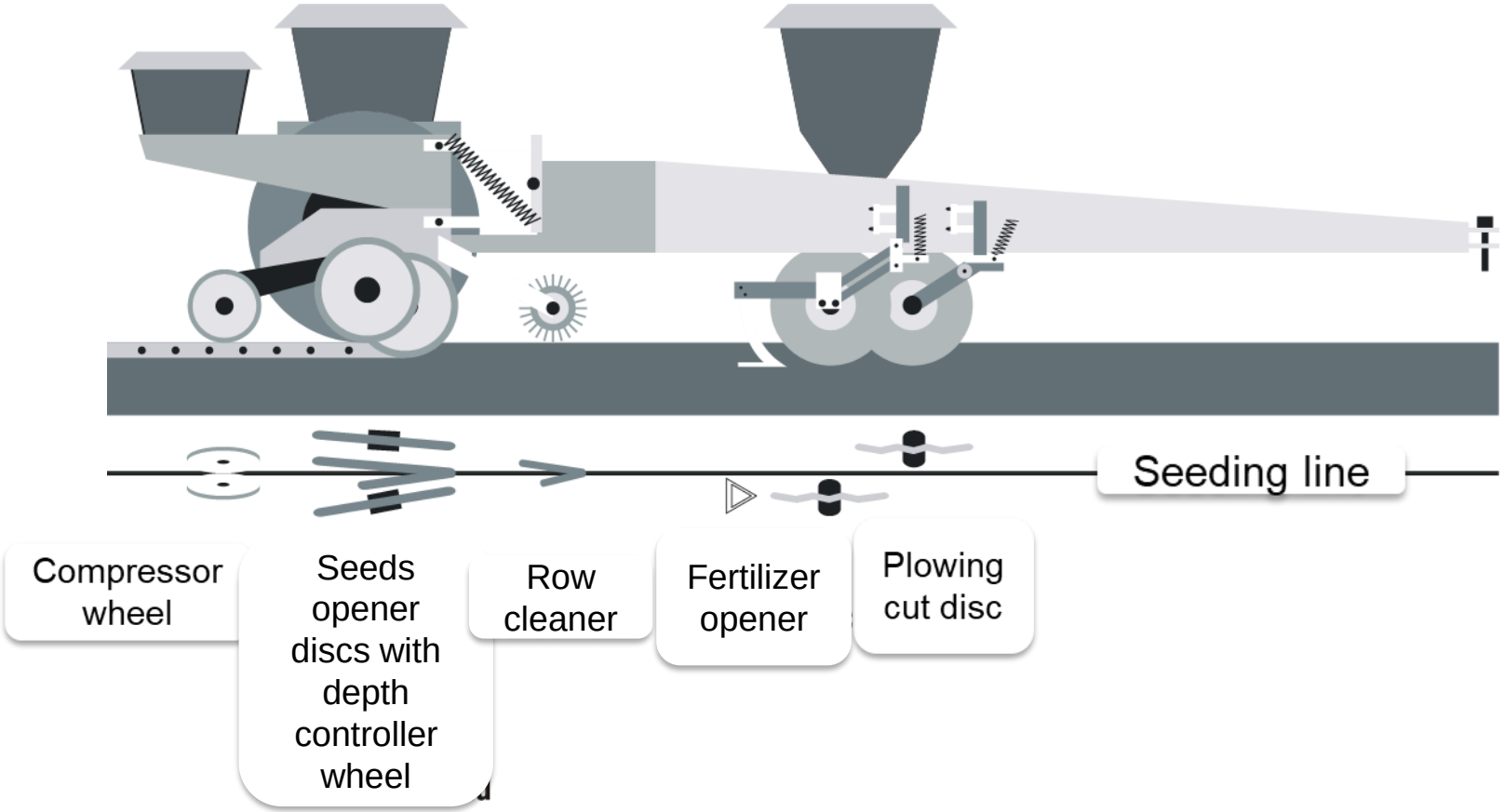
Cereal seeder: design

- Direct seeder for cereals. Components.

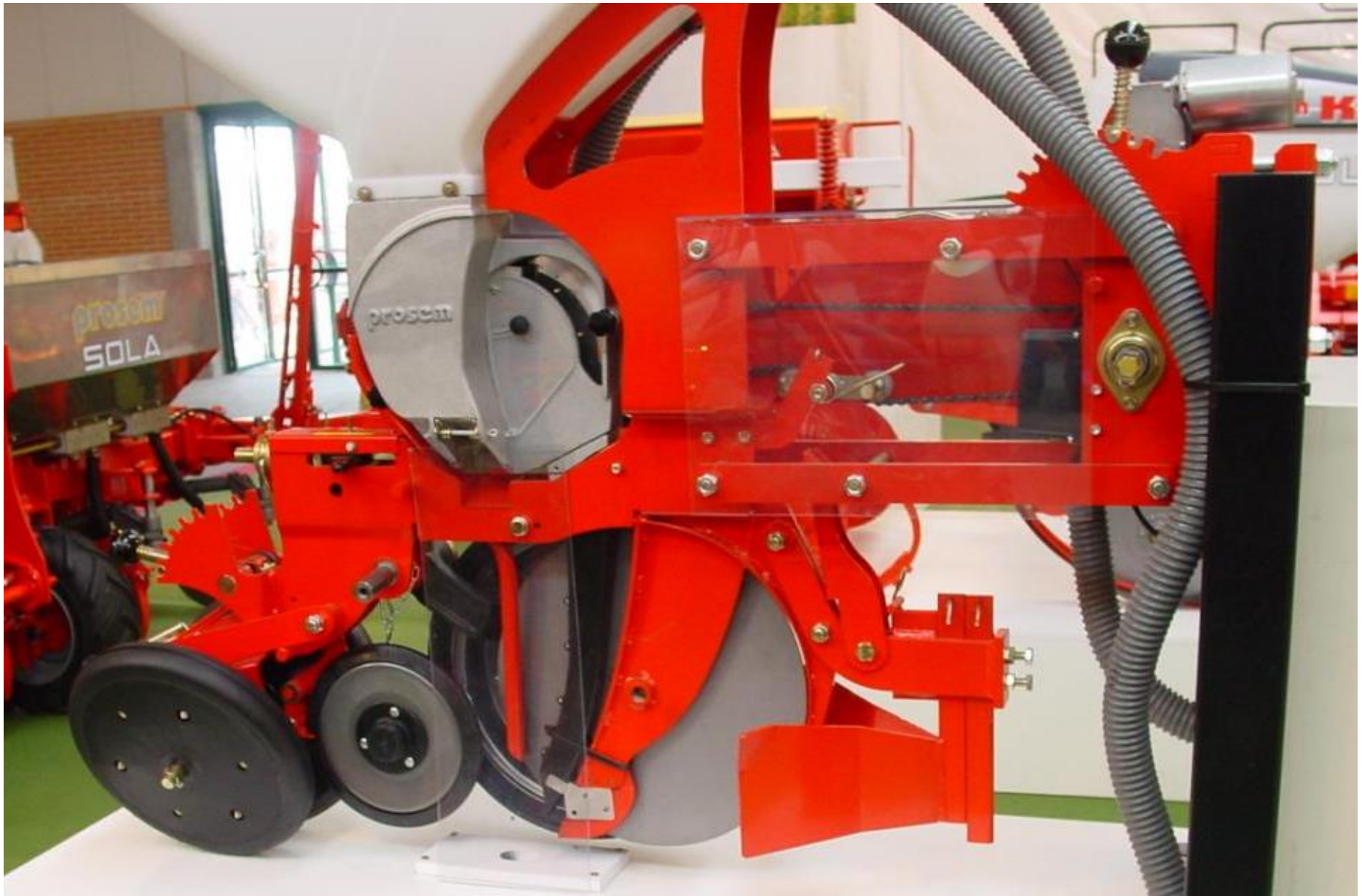


Crop row seeders: design

Direct seeder for cereals. Components



Disk seeder



Tine seeder

How to create a ridge…CA can also make it!

There are several key farming tactics that are proven to be effective in increasing crop production while lowering

1) using **diversified cropping systems** can reduce the system's carbon footprint by 32 to 315 % compared with conventional monoculture systems;

2) improving N fertilizer use efficiency can lower the carbon footprints of field crops as N fertilizer applied contributed 36 to 52 % of the total emissions;

3) adopting intensified rotation with **no-till summer fallow** can lower the carbon footprint by as much as 150 %, compared with a system that has high frequency of summer fallow;



Enhancing

4) enhancing **soil carbon sequestration** can reduce carbon footprint, as the emissions from crop inputs can be partly offset by carbon conversion from atmospheric CO2 into plant biomass and ultimately sequestered into the soil;

Using

5) using **no-till** in combination with crop residue retention can increase soil organic carbon and reduce carbon footprints;

Integrating

6) integrating key **cropping practices** can increase crop yield by 15 to 59 %, reduce emissions by 25 to 50 %, and lower the carbon footprint of cereal crops by 25 to 34 %;

7) including N2- fixing pulses in rotations can reduce the use of inorganic fertilizer, and lower carbon footprints.

With the adoption of these improved farming tactics, one can optimize the system performance while reducing the carbon footprint of crop cultivation under conservation agriculture.

Comparison of different agricultural practices regarding environmental problems.

Crops	Intensity of environmental benefit regarding environmental problems							
	Soil management	Erosion	Soil organic matter	Compaction	Climate change mitigation	Biodiversity	Water quality	Safety of plant protection products application
Annual	CT*	+	+	++	-	-	+	+
	MT	+	+	++	-	++	++	++
	NT	++++	++++	++++	++++	+++	++++	++++
	NT+GC	+++++	+++++	+++++	+++++	+++++	+++++	+++++
Permanent	GC 30%	++	++	++	++	++	++	+++
	GC 60%	+++	+++	+++	+++	+++	+++	++++
	GC 90%	+++++	++++	+++++	+++++	+++++	+++++	+++++

Source: Gonzalez-Sanchez et al. (2015). * Abbreviations: CT: Conventional tillage; GC: Groundcovers; NT: NT; MT: minimum tillage. GC 30%: Groundcovers present in 30% of the surface between the rows of trees; GC 60%: idem 60%; GC 90%: idem 90%. Effect on the environment: + slightly positive; +++++ very positive; - negative or indifferent.

GROSS FLUXES

In tCO_2-e over the whole period analysis

PROJECT COMPONENTS		WITHOUT	WITH	BALANCE
Land use changes	Deforestation	0	0	0
	Afforestation	0	0	0
	Other land-use	0	-104,137	-104,137
Cropland	Annual	0	33,507	33,507
	Perennial	0	0	0
	Flooded rice	0	0	0
Grasslands & Livestock	Grasslands	0	0	0
	Livestock	0	0	0
Forest mngt.		0	0	0
Inland wetlands		0	0	0
Coastal wetlands		0	0	0
Fisheries and aquaculture		0	0	0
Inputs & Invest.		0	0	0
Total emissions, tCO_2-e		**0**	**-70,630**	**-70,630**
Total emissions, tCO_2-e/ha		**0.0**	**-10.6**	**-10.6**
Total emissions, tCO_2-e/ha/yr		**0.0**	**-3.5**	**-3.5**

Preserves soil

Enriches soil

Prevents formation of soil crust

Improves plants growth

CONCLUSIONS