Scientific-professional Workshop

Conservation soil tillage – New/old paradigm of sustainable crop production

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Importance of crop residue management in Conservation Agriculture

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Facts about Conservation Agriculture [CA]

- (CA) is one of the best possible and one of the most effective way for prevention of soil degradation

CA includes three interrelated main principles as bases for successful agriculture production in relation to agro-ecological conditions (www.fao.org/ag/ca):

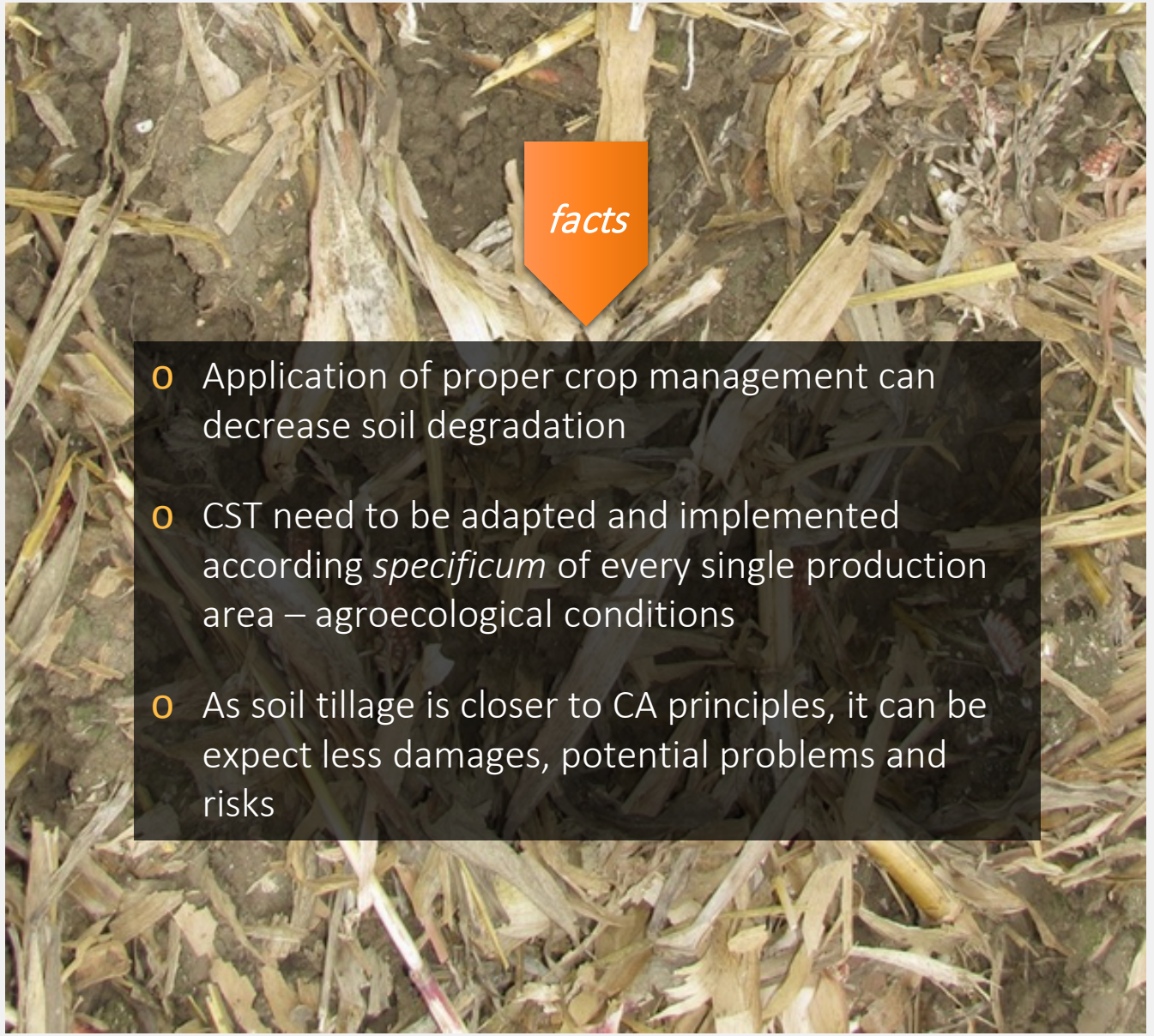
- minimal set of soil tillage treatments (minimal soil disturbance)
- permanent soil cover (with crops or crop residues)
- diversification in crop production (predominantly crop rotation)

CA also uses or promotes where possible or needed various management practices listed below:

- utilization of green manures/cover crops to produce the residue cover,
- no burning of crop residues,
- integrated disease and pest management,
- controlled/limited human and mechanical traffic over agricultural soils

Reasons for Conservation soil tillage - CST (main benefits):

- reduced wind erosion
- reduced water erosion
- erodible land brought into production
- increased options for multiple cropping
- improved soil moisture management (conserves)
- flexible timing for field operations
- improved soil structure
- better humus management
- carbon sequestration (increase OM)
- moderation of soil temperature
- saves fuel and labor
- changes weed dynamics
- improved soil biogenity
- generally: improved physical – chemical – biological properties of soil



facts

- Application of proper crop management can decrease soil degradation
- CST need to be adapted and implemented according *specificum* of every single production area – agroecological conditions
- As soil tillage is closer to CA principles, it can be expect less damages, potential problems and risks

Some negative effects of crop residues on soil surface (Conservation agriculture)

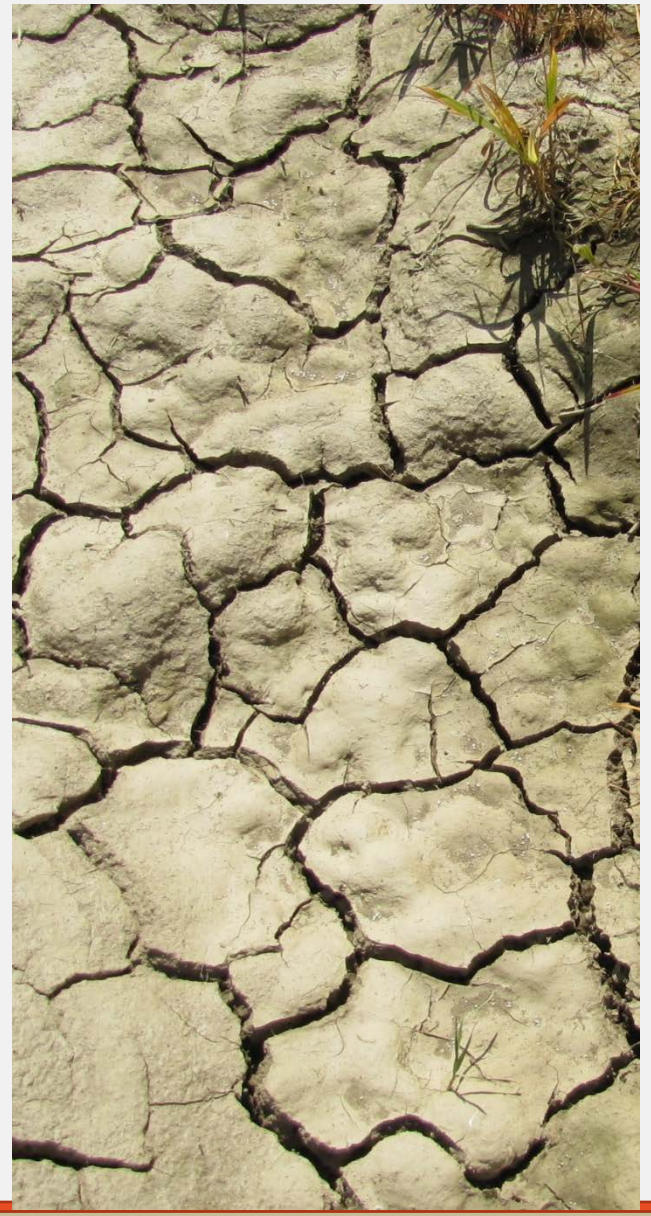
- intensified development of disease
- intensified development of pests
- potential difficulties in application of manure
- potential difficulties in application mineral fertilizers
- potential difficulties in soil preparation
- potential difficulties in sowing
- slower soil surface heating

Reasons for CST - modern principles of soil tillage imply as main:

- excluding mouldboard ploughing as necessary
- less soil tillage trafficking
- better organic matter (residue) management
- prevention to soil degradation (primarily soil erosion)
- shallow residue incorporation or their leaving on soil surface

Residue remains amount and permanent coverage with crop residues are very important and represent key question in CA

Best soil tillage systems in practice is tillage which provide the best (optimal) conditions for crop production with minimum of negative influence on soil state (conditions) adhering to the principles of sustainability

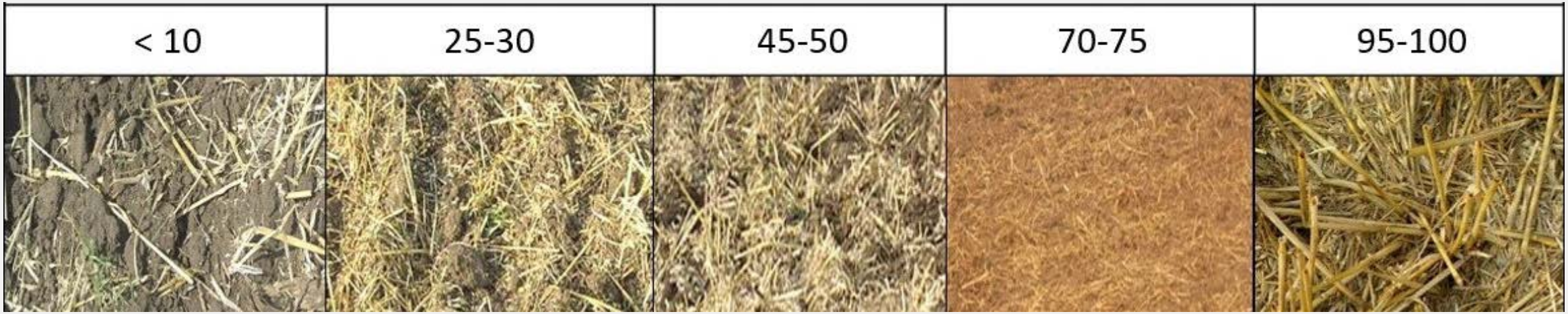


- **Conventional (intensive) tillage systems**
  - leave less than 15% crop residue cover or less than 550 kg/ha of small grain residue

- **Reduced tillage systems**
  - leave between 15 and 30% residue cover on the soil surface or 550 to 1100 kg/ha of small grain residue

- **Conservation tillage systems**
  - leave a minimum of 30% up to 100% of crop residue on the soil surface or at least 1100 kg/ha of small grain residue on the surface

% of crop residue on the soil surface - after tillage preparation for the next crops



Crop residues [CR] – what we know about it?

Crop residues: all mature plant residues after harvesting, including parts of plants above the ground and roots that remain in the soil:

- field crops (stems, leaves, spikes, pods)
- orchards
- vineyards

Historical (traditional) aspect: plant residues represent all useless agricultural plant waste that disturbs agricultural areas and prevents the smooth implementation of agricultural field works

Contemporary (modern) aspect: crop residues represent all agricultural high-value plant material, with potential economic and agroecological value

Competitiveness in the use of crop residues:

- bioethanol
- biogas
- industrial products
- fodder
- stable bedding
- carbon sequestration
- soil health and productivity

Crop residues - solution for healthier and more productive soils

Benefits for the soil

- increases soil productivity (higher yields)
- maintains the level of organic matter in the soil
- improves soil structure
- mitigates water and wind soil erosion
- increases water infiltration
- conserves soil moisture
- "recycles" plant nutrients
- provides habitat and food for micro- and macro-organisms

Benefits for the environment

- mitigates the conditions of over wetting (flooding) of the soil (preventing its runoff into watershed, i.e. loss)
- reduces surface runoff (and sediments loss)
- increases water quality by decomposition and filtering sediments
- reduces non-point pollution
- reduces the risk of hypoxia and anoxia (positive influence on living organisms)

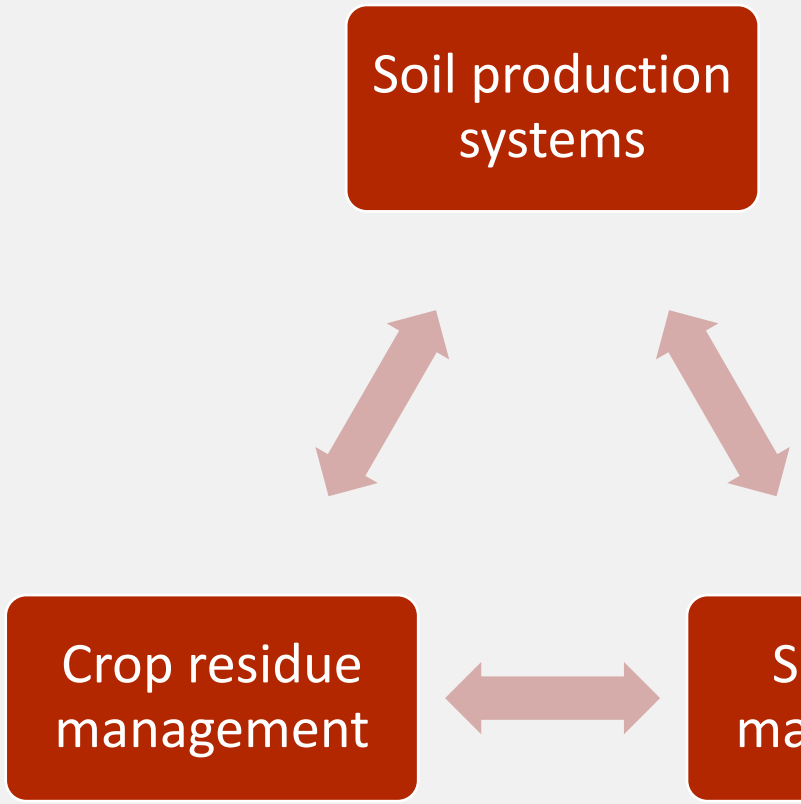
What we do and what do we have to do with CR?

Crop residues, due to the lack of manure and the limited use of green manure, today represent the most important source for soil organic matter build up

Negative tendency → use of crop residues for obtaining energy and for industrial purposes

The negative effects of inadequate (e.g. industrial) use of crop residues are as follows:

- Loss of sources for the supply of organic matter in the soil
- Delay in stubble processing due to the time required for baling and removal of straw bales from the cultivated area
- Deeper warming, greater loss of water, drying, and weakening of biological activity and workability of the soil
- Due to the deterioration of the soil condition, more energy is needed for basic autumn cultivation
- Uncovered, bare soil is exposed to stronger surface heating, the impact of strong rain, and siltation
- More damage by soil compaction (during baling and removal of bales)
- Greater damage from weeds
- Nutrient loss
- Other losses (increased maintenance costs of machines, greater need for mineral fertilizers and reduction of yields)



Basic procedures / measures with crop residues (different approaches):

- incorporation
- soil covering
- mulching (*on site* or *off site*)
- burning on the field
- livestock needs (feed, litter, bedding)
- removal for biomass energy production
- .....

Methods for measuring/assessment crop residues

Estimation of residue cover is primarily useful in planning field operations

Methods for estimation of residue cover need to be performed after all soil tillage operations and after sowing next crop or as for planning next cropping

Three basic methods for estimating percent of residue cover:

A. Line-transect method *[a]*
B. Photo-comparison method *[a]*
C. Calculation method *[b]*

[a] include field observation, repeated measurements for the best averaged results

[b] requires generalizations and calculations, for conservation planning purposes

Final remarks

- Soil tillage management (conventional, reduced or conservation) has direct and indirect effect on crop residue management
- Inadequate soil tillage approach (unsuitable technology) to crop production can resulted with many degradation processes
- Conservation soil tillage is one of the best possible solution to prevail many negative anthropogenic and natural influence of crop production on the soil
- Conservation soil tillage is most often defined as a crop production system where at least 30% of the soil is covered with crop residues
- Measuring/assessment of the amount of crop residue can be performed in several different ways, with prescribed appropriate methodology for each method
- There are three basic methods for measuring of crop residues: a) Line transect, b) Photo comparison and c) Calculation method, and a number of modifications and adaptations of these based methods
- Whichever method of measuring/assessment is used, it is essential for conservation soil tillage to ensure the best possible coverage of the soil surface with the crop residue

Thank you for your kind attention!!!

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