

The Role and Importance of Residues

Crop residues consist of dead plant parts, or stover, that remain from previous crops, including green manure cover crops, and may be supplemented with dried weeds or other imported plant material. Soil cover is one of the most critical factors in ensuring the success of conservation agriculture (CA). In conventional agricultural systems, residues are usually fed to animals, taken off the field for other uses, incorporated or burned. In many places communal grazing rights are observed, and protecting the residues on the fields from free roaming animals can entail considerable conflicts. However, farmers managing CA systems derive huge benefits from surface residue retention, which makes keeping them on the fields very worthwhile, and some communities have found ways to overcome the problems of communal grazing rights.

What are the benefits of surface residue cover in CA?

- Increased water infiltration.
- Decreased water evaporation.
- Increased water available to crops.
- Less soil erosion from both water and wind.
- More biological activity.
- More soil organic matter and available nutrients.
- Moderated soil temperatures.
- Fewer weeds.



Photo: Christian Thierfelder

Soil covered with maize residues before seeding. Some of these residues have been eaten by termites.

How is water infiltration increased by crop residues?

On a bare soil, surface aggregates, already weakened by tillage, are broken down by the explosive impact of heavy raindrops. The dispersed soil particles block soil pores and seal the soil surface, thus impeding water infiltration. In CA systems the residues protect the soil surface and water infiltration is increased as shown in the graph below. Also, under CA systems there are more soil pores because of the increased biological activity with continuous residue cover and because the pores are not continually broken down by tillage.

How do residues reduce moisture evaporation?

Surface residues protect the soil surface not only from raindrops but also from the sun's rays. Radiation evaporates water— if one moves the residues aside you will normally find moist soil underneath. The residues also protect the soil surface from the drying effect of the wind.

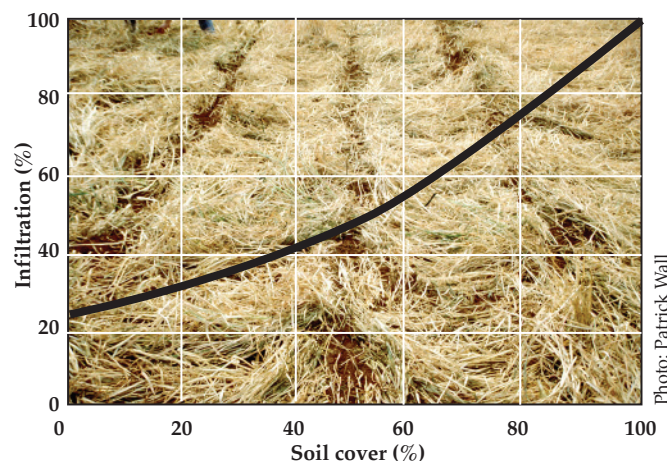


Photo: Patrick Wall

The relationship between surface cover with residues and water infiltration (Roth et al., 1988).

How do residues increase water availability to the crop?

Because residues increase infiltration, more of the rainfall goes into the soil and less is lost by evaporation, so that there is more water in the soil for crops. Some of this extra water may be lost to the crop by drainage, but in most conditions, especially in dry areas or periods, there is more water available for the crop.

How do crop residues protect against soil erosion?

Because more water goes into the soil (increased infiltration), less water runs off the land. Also the residues slow the flow of runoff water across the land. The combination of these two factors leads to large reductions in water erosion. Residues also protect the soil from the wind, and as the soil is not loosened by tillage in CA systems, there is markedly less wind erosion.

How do crop residues increase biological activity?

Residues provide a constant food source for soil fauna and flora, and a habitat for many organisms. Therefore populations of soil organisms increase under CA. Many of these are beneficial: they may produce soil pores or attack crop pests. Under “clean” tilled agriculture only the crop is present and there is no food source except the crop for soil organisms, and there is no habitat for predatory insects.

How are soil organic matter (SOM) and plant nutrients affected by crop residue retention?

The increased biological activity with crop residue retention also enables the slow breakdown of the residues and their progressive incorporation into the soil as organic matter. Lack of tillage in CA systems means that this SOM lasts longer in the soil as humus. Plant nutrients associated with humus are more available than inorganic forms of the same nutrients. Surface residues may, however, sometimes immobilize nitrogen, and in the first years of CA on very degraded soils, a little more manure or nitrogen fertilizer may be necessary.

Do crop residues have an effect on soil temperature?

Residues shield the soil surface from solar radiation, and so the soil does not heat up as much during the day. At night the residues act as a blanket, keeping the soil warmer. In some cold climates, cooler soils may cause problems for seed germination but this is unlikely in tropical areas.

Do crop residues affect weeds?

Weed germination and growth is hampered by residues: under normal residue amounts, some weeds will remain but a reduction in weed numbers can be seen. However, when combined with other weed management practices, residues help reduce weed populations over time in CA.



Photo: Patrick Wall

Pores made by soil fauna (arrows) are evident after moving aside the surface mulch.

Residues are the key to successful CA - without them the full benefits are never achieved.

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