Importance of Crop Residue Management in Conservation Agriculture

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Summary

Climate Change (CC) today represent one of the most important and challenging existential threats at the local, regional and global level. These negative influences, which arise from drastically changing climate, are visible in all humans and natural aspects and sectors. One of the most important aspects, which is strongly connected with climate change and which is inevitably in a causally consequential relation relationship with it, is agriculture. To prevail these negative influences, many platforms strive to found some valuable and adequate sustainable approaches, measures and techniques. Many techniques (such as soil tillage, seeding/sowing, crop/plant protection, crop residue management) in crop and plant production, which is usually called "conventional", they are no longer adequate. They should be promoted/updated/renovated/upgraded/adapted into sustainable techniques. According aforementioned "many platforms", Conservation Agriculture (CA) belongs to the one of these and represent very successful platform in adaptation and mitigation strategy to CC. CA is highly adaptive concept and with relative very easy applicative measures on different levels; on local, regional and global scale.

CA as measure of adaptation to CC is based on three basic principles:

- Minimal soil mechanical disturbance,
- Permanent soil surface cover (with crop residues and/or growing crops),
- Crop rotation (species diversification).

All three basic principles are interconnected by crop residues, as one of the most important factors of CA, on different ways and levels, as it: way and intensity of soil tillage, mass and type of crop residue, type of crops, biological yields, harvesting quality, activity of soil biology, soil chemical and physical quality, agroecological conditions, crop residue management, etc. Most often definition of CA is according amount of crop residues on soil surface. According this criterion CA is defined as a crop production system where at least 30% (up to 100%) of the soil surface is covered with crop residues after all tillage treatments and sowing/seeding are performed. In comparison to CA, and using same criterion, conventional soil tillage with plowing has up to 15% and reduced soil tillage up to 30% (usually from 15-30%) of crop residues on soil surface.

Crop residues and their retention on the soil surface or near the soil surface have multiple and significant mostly positive, but in some cases conditionally negative impacts, especially in soil conservation tillage systems. Different effects of crop residues (positive or negative) on soil conditions and crop production (current and next growing crops) resulted from many factors, such as: amount, type and fragmentation of crop residues, different soil conditions in residues management, type of climate (dry or wet conditions), type of mechanization, intensity of crop rotation (short or intensified), etc. Generally, negative effect is mainly expressed through intensified development of disease and pests, slower soil surface warming and potential difficulties in soil preparation and sowing (large amount of residues). As the most important positive effects can be highlighted next: reduction of water and wind erosion, reduction of evaporation, better water infiltration, better water preserving, reduction of weed infection, intensification of soil biota etc. It is clearly visible from the definition that crop residues play a very important role in CA, and for this reason special attention is paid to this issue.

Measuring/assessment of the amount of crop residue can be performed in several different ways, with prescribed appropriate methodology for each method. The basis of each measurement method is that it is carried out after the sowing of the next crop, and the measured values are expressed as a percentage of the soil surface coverage with crop residues. There are three basic methods for measuring of crop residues:

a. line transects method (most popular and easy to use),
b. Photo comparison method (more possibilities: photo camera, drone, remote measurement – satellite, radar polarimetry),
c. Calculation method (complicated, demanding and time-consuming in creating but very easy to use).

There are number of modifications and adaptations of these based methods and it is important to emphasize that each method has its advantages and disadvantages, and that accuracy of the results depends on a large number of parameters (e.g. precision/calibration of the method, data collecting method, agroecological and agrotechnical conditions). But 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.

Case study: The field experiment with different conservation tillage systems, different fertilization and soil conditioners, and different crops in rotation was conducted in 2021 in two different agroecological region in continental part of Croatian. Tillage treatments were: ST (standard tillage; plowing up to 30 cm and different number of secondary tillage treatments), CTD (conservation deep tillage; loosening up to 30 cm with a minimum of 30% of crop residues on the surface) and CTS (conservation shallow tillage; tillage up to 10 cm with a minimum 50% of crop residues on the surface). Method for estimation of residue cover (in %) was line-transect method, and it was performed after all soil tillage operations and after sowing next crop. Already in early stage of research, after second experimental year (maize was grown in first and soybean in second year) percentage of crop residue was higher than is expected, but in expected distribution on both experimental sites. Higher soil covering was measured in western part of Croatia and lower in easter part. As it expected, highest soil covering was on CTS on fertilization according recommendation with application of liming and lowest on ST with decreased fertilization without liming. Generally, soil surface covering with crop residues according treatments were as follows: CTS>CTD>ST.

Key words: conservation agriculture, conservation soil tillage, crop residues, maize, soybean

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