Using different tillage to less environment pressure

Introduction

In Nature everything cycles. Annual carbon (C) removal, C exchange between the "reservoirs", occurs because of various chemical, physical, geological and biological processes. Carbon is a component of the organic matter (OM) and in nature it is in form of organic and inorganic compounds. Permanent transition of one form into another, through a series of biochemical reactions, represents C cycle in nature.

Today world is exposed to the changes that are becoming noticeable with permanent consequences for humanity. Only few wonder if human influence is main culprit for these changes. Too much carbon dioxide (CO_2) in the atmosphere from burning fossil fuels has drawn the attention of scientists. Apparently this excess is causing global warming, which could change our weather patterns and drastically affect our lives. Through the activities, the man and his actions upset the balance established between soil and vegetation. Agriculture participates with 7% of CO_2 emissions in the atmosphere, of which soil menagement with 42%. Storaging C in the soil could reduce the amount of gases generated by agriculture, and the way to provide this is the optimal soil management. Soil C stored in the form of OM, is only 1-3%, and in the most important economic soils is from 2.1-2.8%. Other researchers say that C concentration in the humus form is up to 5%, and globally speaking, amount of organic C in the soil is three times greater than the above-ground plant mass, and twice compared to the atmosphere.

Dying of flora and fauna the transformation process of OM begins: mineralization or humification, depending on the current conditions in the soil. Under certain environmental conditions, the decomposition of OM (humification and mineralization) with adoption of new, fresh organic substances dynamic balance is established. Thus maintain the balance amount of humus, that is most stable organic C fraction. When soil conditions are changed, direction and intensity of transformation are also changing.

By land use changing, and the expansion and intensification of tillage and deepening active soil depth the process of intense mineralization of OM has been initiated and still in process. Mineralization is process present in all agricultural soils. U.S. and Canadian experience shows that on grain-growing belt in 70 years of intensive crop farming decreased the natural fertility of the soil about 40%, at the expense of OM and nitrogen in the soil. First of all, reduce the amount of OM is determined by the influence of tillage, then other methods

of soil management, such as fertilizers introduction, lack of solid crop rotation, removal of crop residues, and reduction in the use of solid compared to liquid manure.

Different tillage systems affect the composition, distribution and amount of C (humus) in the soil. For maintaining the level of soil OM all available crop residue should remain on field area or enter into the soil. Burning of biomass should be avoided, and fertilizers input should be adjusted for the acquisition of high yield. Fertilizers usage and plant mass entry into the soil can increase the level of soil OM and contributes to the favorable balance of nitrogen in the soil. Combined fertilization, with liming, have a positive impact on the most chemical properties of soil, including OM content.

Selective crop rotation and reduced tillage or no-tillage will also maintain a level of OM in the soil. Organic plant biomass should increase and improve fertility by legume and other grass species cultivation that provide a source of nitrogen. Solid crop rotation with perennial grass and clover-grass mixtures, and the incorporation of manure, should increase the weight of entered plant substances. In order to favorable impact of growing crops in crop rotation on OM (humus), as part of sustainable land management, as opposed to monoculture, farming in crop rotation is preferred. This mainly applies on those crop rotation in which the legumes are present. Wherever crop rotation contained perennial legume as first crop, soil contains higher amount of OM with no-tillage compared to conventional tillage. OM remained in the humus form is considered as the largest portion of organic C, and represents constant fraction of C the soil.

Influence of tillage on soil carbon (Organic matter)

Each tillage is in the final logical consequence artificial and unnatural intervention. Tillage affects the mineralization and humification processes, and as "consequence" is humus content in the soil. Tillage has the task to repair the structure, suppress weeds, bringing fertilizers to the soil and conserve soil moisture. With development of tillage there have been appeard permanent loss of soil humus. Remained plant vegetation disposed on the surface, and remained roots and flora and fauna are a constant source of soil organic components. With destruction of natural vegetation and soil cultivation human has upset the balance between the soil and vegetation.

Tillage accelerates the decomposition of humus and reduces its content. In the beginning the decomposition runs faster with a greater content reduction , and continues more slowly because of harder degradable residues. Humus content loss with rapid mineralization

of OM is particularly high in arable soils. It suggests that during agricultural operations it should be careful about the cycle of OM returning in the soil. The speed of which OM decreases depends on the system of land management and use of agricultural soil. Research tillage systems can improve the productivity of the soil, and studies have shown that the manner of tillage may act differently on OM. Each tillage system adapted to existing environmental conditions and the needs of crops grown within specific farming systems. There is no universal tillage system. Every tillage follows the environmental conditions of plant production. Tillage systems are subject to constant changes. The best tillage systems are maximally aligned with environmental conditions and requirements of grown crops, while at the same time production cost has to be the lowest.

Intensive tillage accelerates decomposition of OM. For that reason conservation tillage systems are introducing in general use. In contrast to conventional tillage systems relating to soil overturn, conservation tillage relies on loosening. If soils are permeable and loose, tillage may be omitted altogether. Conservation tillage could be regarded as any tillage system that reduces the loss of soil and water in comparison with systems that leave the soil surface flat and clean. Conservation tillage is a tillage system in which it retains at least 30% plant residue cover on soil surface after planting. Reduced tillage is a form of conservation tillage, which uses 30% of the cover, and it is actually a combination of tillage under the mulch and partial tillage at sowing zone. Since 37% of agricultural land in the U.S. is currently using conservation tillage, and is estimated to increase to 75% by 2020., became more and more important to understand the potential and limitations of these land management practices for agriculture under different environmental conditions and production systems.

Conservation tillage have many variants or subtypes depending on its purpose. Conservation tillage systems can be no-till, zero-till or direct drilling, and reduced tillage system which is also called minimum (reduced tillage / minimum tillage).

No-tillage is energetically and economically extremely effective and efficient in terms of soil protection from erosion. Consumption of work for soil preparation and sowing is reduced by 50%, water conservation is increasing and OM (humus) degradation is reducing. Minimum or reduced tillage system has been introduced to reduce the depth of primary tillage, numbers of machinery passing reduce to minimum, and to reduce secondary tillage operations. Tillage, fertilization, planting and herbicide aplications associated in a joint operation, and mulch is left on the surface, if possible, all the time.

The mechanism by which the soil OM retains in conservation tillage systems may be due to reduced availability of oxygen below the soil surface under the No-tillage, which

affects the rate of degradation and distribution of aerobic and anaerobic microorganisms and microbial processes.

Since soil tillage is blamed for increase CO_2 emissions, many researchers have monitored CO_2 emissions from the soil under the influence of different tillage systems. The difference in CO_2 emissions between conventional and reduced tillage in period of 40 days is 580 kg C ha^{-1},under the influence of crop residue decomposion and mineralization of humus. The amount of C released by mineralization of humus increased by 270 kg C ha^{-1} in conventional tillage plowing than in no-till tillage and represents additional loss of 0.48% organic C content of arable layer (0-30 cm), as a result of plowing in the warmest time of year. Short-term effect of tillage on CO_2 and mineralization rate was higher when the temperature is increased due to tillage. During crop residue decomposion part of C is incorporated into the soil microbial biomass, and the other part is emitted as CO_2.

A great majority of researchers identified the accumulation of C in the no-till tillage system compared to conventional tillage. Reduced or no-tillage is one of suggestions to mitigate the negative trend of reduction of OM in the soil. C storage in soil through humification is important because OM affects many physical and chemical soil properties.

Many authors have determined advantages of no-till compared to other tillage systems - a significant increase in organic C at a depth of 0-10 cm under no-till compared with conventionally tilled soils. In a number of experiments conducted in humid regions, no-tillage increases soil organic C by an average of 3 Mg ha^{-1} compared with conventional tillage with moldboard plow. Eventually, conservation tillage improves soil quality parameters, including C sequestration. Also, increased losses of soil organic C were documented where conventional tillage had been applied. In the study, after 4 years of conventional tillage, initial loss of OM was determined by 10%, while the estimated loss of soil OM caused by conventional tillage was 16 to77%. Reduced tillage should be used in soils due to increased OM and reduce the humus mineralization in soil.

Conclusion

1. Factors that determine humus content as a permanent C source in soil were: air, soil type, relief and vegetation, and land use. However, the factor that most affects transformation rate of OM (humification or mineralization) is tillage, which accelerates the decomposition of humus and reduces soil OM.

2. Different tillage systems affect the direction and intensity of OM transformation in the soil, but there is no universal way of tillage to be applicable for all soil and climate conditions. There is a positive effect of no-till and reduced tillage on soil OM compared to conventional tillage. Eventually, conservation tillage improves soil quality indicators, including the storage of organic C.

3. In general, amount of humus and OM increased at reduced tillage in the surface layers, and found a direct effect of soil microbial activity on the direction and intensity of transformation. Changing the water and air conditions in the soil, tillage affect the microbial activity and through it to CO_2 release from soil OM.

4. Only by adoption of new, fresh organic matterial dynamic balance is established, so it is recommended not to disturb the balance by turning soil with ploughing, but loosening with adoption of reduced or no-tillage. Changing conditions in the soil, direction of OM transformation changes which affects the amount and character of humus. Reduced contact of crop residue with soil and extreme variations in moisture and temperature on soil surface play a significant role in reducing the decomposition rate of surface residues.

5. Insertion of fresh OM in the soil by solid domestic manure and green fallow slows down the mineralization process. Mass of underground parts of plants should increase by legume production to enrich the soil with OM, but also for nitrogen. Using crop rotation in combination with cereals or perennial growing grass mixtures, grass-clover or clover-grass mixtures should increase the weight of entered plant material.