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Investment Insight

Cover crop management: trade-off between gaining soil carbon benefits and maintaining crop yield

Dr. Kaiyu Guan and his colleagues from Agroecosystem Sustainability Center (ASC) at the University of Illinois have discovered how to quantify the soil organic carbon (SOC) benefits from cover crops in corn-soybean rotations.

Their study, published in Global Change Biology, used *ecosys*, an advanced process-based ecosystem model, to assess the impacts of winter cover cropping on SOC accumulation under different environmental and management conditions, which is benchmarked on cover crop field experiments across the whole state of Illinois conducted by Dr. Villamil's team, also funded by NREC.

This new study found that cover crops are effective in increasing SOC by sequestering atmospheric CO2 into the soil, and thus have a positive impact to enrich soil fertility and mitigate climate change. Researchers took an ecosystem modeling approach to quantify SOC benefits from cover crops. Their study revealed that growing cover crops can increase SOC by an average of 0.33 megagrams of carbon per hectare per year (which is equivalent to 0.54 tons of atmospheric carbon dioxide per acre per year) in Illinois, and that SOC benefits can be improved through increasing cover crop biomass (Figure 1a). Cover crop SOC benefits are positively correlated with cover crop biomass since the additional SOC benefits from cover crops mostly come from cover crop residues.

The study further found that management practices such as selecting specific cover crop types and controlling the cover crop growth period are major controlling factors of SOC benefits from cover crops. This means that cover crop benefits can be maximized through management practices. Specifically, later terminating time results in longer growth windows for cover crops and larger biomass production, which contributes to larger SOC benefits from cover crops (Figure 1b). In addition, cold-tolerant species also have larger SOC benefits compared to other species since they achieve larger biomass in Illinois which has cold winters. Even though longer cover crop growth periods and cold-tolerant species both lead to larger SOC benefits from cover crops, it's important to note that there are other metrics to consider besides SOC benefits, such as reducing nutrient loss and improving soil fertility. In general, cover crops need to be well managed to achieve their potential benefits, and the optimal management strategy could vary field to field.

This research demonstrated that the *ecosys* model not only helps quantify SOC benefits from cover crops, but also improves the scientific understanding of environmental factors that control SOC. In addition to SOC benefits, the researchers also found that cover crops could benefit the soil environment in other ways, such as reducing soil compaction, improving water infiltration and reducing soil erosion. The *ecosys* simulations indicated that the amount of carbon stored in microbes in soil increased when cover crops were present. The researchers are now quantifying cover crop impacts on soil erosion reduction and nutrient leaching reduction through the *ecosys* model.

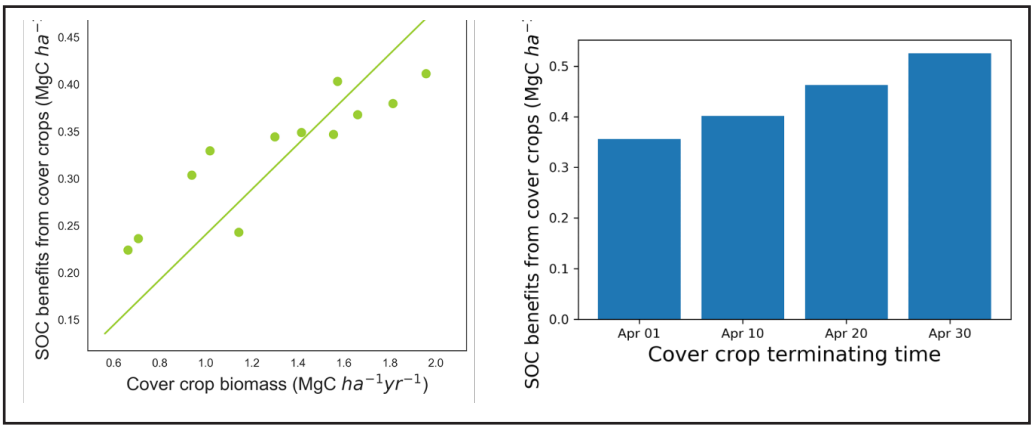

Figure 1. (a) Relationship between cover crop biomass and SOC benefits from cover crops among six cover crop sites in Illinois. (b) SOC benefits from cover crops under different cover crop terminating time at the Monmouth cover crop site.

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