

Cover Crops: A Step to Sustainable Farming

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Abstract:

Cover crops are not just meant to cover soil but offer wider benefits while sustaining crop productivity and soil fertility in a large number of climatic conditions. Cover crops still widely in use are long praised for their abilities to stop soil erosion, fix atmospheric nitrogen, stop nitrogen leaching, and enhance soil health. Cover crops attract pollinators, used as green manure and feed for livestock. Climate change is real and requires mitigation strategies; the practices that reduce anthropogenic forcing of the climate system. Thus, it has become very critical to evaluate conservation practices that sustain soil and water resources from climate change. In recent decades, the resurgence in the adoption of cover crops coincides with a greater understanding of climate change. This article assesses the possibility of cover crops to help with climate change by juxtaposing all of the positive and negative effects of cover crops on the net global warming potential of agricultural fields.

Introduction:

Cover crops are generally defined as the crops which are used to cover the ground surface. Globally, food production is facing a significant challenge: how to increase crop output while using fewer resources and having less of an environmental impact. Global agro ecological systems may be negatively impacted by climate change. In numerous locations around the world, soil and water resources are already in danger, and agricultural productivity is in jeopardy. On the other hand the conservation practices are generally difficult to adopt for resource-poor farmers due to the high costs involved while focussing on sustainability. Cover crops are precisely grown to protect the soil from erosion and prevent the loss of nutrients in deep layers through leaching and surface runoff.

Cover crops have four types 1. Legumes: alfalfa, vetches and clover 2. Non-legumes: spinach, canola and flax 3. Grasses: ryegrass and barley 4. Brassicas: radishes and turnips. Legumes and non-legumes are the two primary categories of cover crops. Legume cover

crops can increase soil organic matter and organically fix nitrogen (N). They can be applied as green manure to enrich the soil's nutrient content for the following main crop. The non-legume cover crops can boost crop biomass, remove excess nitrate from the soil and enhance soil quality.

When only one major crop is planted, cover crops (sometimes referred to as catch crops) are plants that are often grown after the main crop is harvested. This avoids the exposed patches of soil which reduces the impact of erosion and nitrogen losses, and the field is never left completely fallow. Hence, to avoid competition with the main crop and additionally improve the mineralization of organic nitrogen, cover crops might be destroyed (or ploughed in soil) in the winter or spring, or grazed to manage weeds and nitrogen inputs and prepare the soil for the planting of a primary crop under no-till. They can also be left on the soil's surface during the autumn and winter.

Characteristics of cover crops:

- Cover crops are paramount for enhancing environmental sustainability, lowering agricultural inputs, and enhancing soil quality.
- Improvement in soil properties such as porosity, aggregate stability, water holding capacity, microbial population size and activity, and nutrient cycling can all be attributed to cover crops.
- From recent studies, cover crops have also been used to increase exchangeable nutrients like K^+ and Mg^{2+} and to reduce weeds in crops.
- Various long-term experiments reveal the economic significance of cover crops.
- The killing mechanism, pathogen-host, regeneration, and lack of rapid advantages are only a few of the issues with cover crops.
- Despite the few drawbacks, cover crops enhance the general condition of the soil and give the primary crops a stable habitat.
- In addition, cover crops have a role in pest management as they can break pest cycles and control weeds.
- A green manure effect can come from the mineralization of CCC residues, and even more from legume CCC. Alternatively, CCC can be harvested and used or sold as livestock feed.

- Cover crops make it easier for mycorrhizal fungi to colonize the soil. Mycorrhizal fungi also aid in crop survival and early crop development, particularly in cotton which helps plant roots to aid in the absorption of nutrients and water.

Can we use cover crops to mitigate climate change?

Generally, strategies used to lessen the effects of anthropogenic climate change are referred to as climate change mitigation practices. Reduced greenhouse gas emissions, less nitrogen fertilizer production, and increased soil as a sink for greenhouse gases are only a few of the biogeochemical mitigation measures used in agriculture systems. Cover crops, directly and indirectly, help with reducing the impact of climate change. By reducing erosion from rain, retaining mineralized nitrogen owing to warming, and expanding options for managing soil water during soil saturation or droughts, cover crop management aids in climate change adaptation. However, the climate should be taken into consideration when choosing cover crops. Compared to no-till mitigation, cover crops can reduce warming caused by greenhouse gas flux by 100–150 g CO₂ e/m²/year. Research suggested the role of cover crops in altering the surface albedo in comparison to no-till mitigation between 12 and 46 g CO₂ e/m²/year over a 100-year period.

Conclusion:

Cover crops have a significant impact on reducing soil erosion (both water and wind erosion), improving soil structural properties (aggregate stability), improving soil hydraulic properties (water infiltration), enhancing the soil organic carbon and soil microbial population, and reducing nitrate N leaching. Cover crops improve the overall health of the soil and, as a result, lower groundwater pollution. Cover crops reduce greenhouse gas emissions and aid in climate change adaptation. Varied advantages of utilizing cover crops depend on the species chosen (legumes, non-legumes, grasses, and brassicas) when the crop is planted and harvested, and how it is harvested (mechanically or chemically). However, numerous potentials still need to be unlocked, such as the allelopathy and effect of employing cover crops and its relationship with albedo, the usage of various cover crop combinations, and their management techniques for enhancing soil health and quality.