What is Carbon Sequestration?

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Carbon sequestration is the process of capturing and storing carbon dioxide. When left unsequestered, an over concentration of carbon dioxide contributes to the negative effects of climate change. Understanding the effects of carbon dioxide and learning how to implement mechanisms for carbon capture and storage are the first and most important steps in reducing carbon emission while improving on-site soil health for your operation.

Effects of Carbon Dioxide

Carbon dioxide is a natural occurring greenhouse gas that absorbs and radiates heat. However, because we put more CO_2 into the atmosphere than natural processes can remove, atmospheric CO_2 increases each year, at a rate 100 times faster over the last 60 years than previously. This has many lasting effects on environmental characteristics, such as global temperature rise.[1] Whereas recent trends signify a decrease in emissions, anthropogenic CO_2 production is still increasing faster than natural processes can remove, implicating the need for mitigation.[2]

As outlined by the Intergovernmental Panel on Climate Change, agriculture, forestry, and other land use is of great importance for climate change mitigation.[3] This sector is highlighted, as it possesses the opportunity to:

(i) turn a source of atmospheric CO_2 to a sink;
(ii) provides an abundance of biomass and bioenergy with or without carbon sequestration intent;
(iii) produce non-CO_2 emissions from agricultural production;
(iv) engage with additional sustainability programs other than that of specific climate mitigation. [4-9]

These highlighted reasons allow growers the opportunity to participate in biological carbon sequestration events to aid in reducing atmospheric CO_2, becoming an agent of positive change.

Biological Carbon Sequestration and Best Management Practices

Biological Carbon Sequestration is the storage of carbon dioxide in vegetation, soil, and oceans. Soil and plant matter naturally sequester carbon and are practical means of carbon sequestration within a farming landscape. In doing so, soil health can dramatically benefit, resulting in improved plant health and potentially increased crop yields. The key to reaping these benefits lies in the soil. Soil acts as both a source and a sink to this atmospheric CO_2.[10] As a sink, fields can store greenhouse gasses. Through photosynthesis, crops convert carbon dioxide from the atmosphere to oxygen, storing carbon in the vegetation and the soil in the process. This carbon is stored in the soil unless otherwise disturbed. Implementing agricultural conservation practices can reduce this soil disturbance, increasing carbon sequestration and soil health. Adopting no-till farming practices and strategies increase soil carbon concentrations and storage potential. It has been found that a reduction of tillage can increase soil organic matter content from 0.8% to 22.1%, water aggregate content from 1.3% to 13.6%, and can improve water permeability of your soil. [11]

Other methods to increase your soil's carbon composition include the installation and maintenance of your pollinator habitat. As a source of soil carbon, pollinator habitat can be seasonally temporary or permanent. Installations of permanent habitat, such as hedgerows and set aside plantings, are effective ways to increase vegetative matter, decrease soil disturbance, and ultimately increase carbon sequestration. As found in a recent study, implementing hedgerows along agricultural field edges can result in higher soil carbon throughout the first 100 cm of the soil profile relative to cultivated fields. [12]

Temporary habitat can be implemented within and around your farm through methods such as the installment of cover crop. Examples have shown that installations of cover crop led to a significant increase in soil organic carbon stocks, with a mean annual carbon sequestration rate of 0.32 ± 0.08 Mg/hectare/year to an average increase of up to 16.7 Mg/ha and the inclusion of cover crops rather than allowing fields to fallow can increase the soil carbon stock and can be effective means to attenuate anthropogenic greenhouse gas emissions. [13,14]

Carbon farming, the application of strategies that sequester soil on site, as a product of implementing pollinator habitat in and around agricultural fields can take many forms and is adaptable to a variety of farm groups. Using the CDFA's version of the COMET-planner, Sardiñas *et al.*, found the potential carbon sequestration of various conservation practices and their applicability to agricultural landscape, found in below *Table 1.* [15] These strategies and their found carbon stock aid in the decision making process for implementing on site carbon sequestration practices suitable for your farm.

Table 1.

Units: mt- metric tonnes, ac-acre, lf- linear foot

Practice	Description	Pollinator Benefit	Unit	Carbon Sequestration Potential (mt)
Conservation Cover	Permanent vegetative cover of forbs grasses and/ or legumes	Provides floral and nesting resources	ac	0.6
Cover Crops	Temporary plantings during fallow winter or summer periods, or as a seasonal understory in perennial cropping systems	Provides floral forage resources when allowed to bloom before terminating or mowing	ac	0.4
Field Border	Strip of permanent vegetation established at the edge of a field	Provides floral and nesting resources	lf	0.9
Hedgerow Planting	Establishment of woody vegetation along field edges	Provides floral and nesting resources	lf	0.9
Range Planting	Establishment of perennial or self-sustaining vegetative grasses, forbes, legumes, shrubs, and trees on rangeland	Plant flowering, non- invasive species	ac	0.3
Residue and Tillage Management - No Till	Eliminate soil disturbance and manage plant reside	Helps promote ground nesting bees	ac	0.2
Residue and Tillage Management - Reduced Till	Limit soil disturbance and manage plant reside	Helps promote ground nesting bees	ac	0.1
Riparian Forest Buffer	Permanent woody vegetation along riparian areas	Native tree species provide habitat and resources for pollinators	ac	2.0
Riparian Herbaceous Cover	Permanent herbaceous vegetative cover along riparian areas	Provides floral and nesting resources	ac	0.2
Tree/Shrub Establishment	Tree or shrub establishment by seeding, planting, or natural regeneration	Native trees and shrubs provide floral and nesting resources	ac	19.0
Windbreak/ Shelterbelt Establishment	Single or multiple rows of trees or shrubs to achieve specific benefits.	Trees, vines, and shrubs can provide pollen and nectar resources. Can be used as pesticide drift barrier with correct applications	lf	0.9

Table 1. From Sardiñas *et al.*, 2023. CDFA and NRCS approved carbon farming practices that support and benefit pollinators.

Resources

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