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Understanding Carbon Terminologies

(*Manisha Tamta[1], Shivani[1], Madhu Chaudhary[2], Kumari Shubha[1], Abhishek Kumar Dubey[1], Ujjwal Kumar[1], Abhay Kumar[1] and Sanjeev Kumar[1])
[1]ICAR-Research Complex for Eastern Region, Patna-800 014
[2]ICAR-Central Soil Salinity Research Institute, Karnal-132 001
*Corresponding Author's email: tamtamanisha16@gmail.com

For life to exist, carbon is necessary. Carbon is regarded as the 'King of the Elements' in the periodic chart. Everything in our environment, including the clothing we wear, the food we consume, and the luxuries we enjoy, is made of carbon. In one way or another, carbon exists in all organic materials. All living organisms contain carbon. It comprises 18% of the total human body and is the building block of proteins, carbohydrates, sugars, etc. Our diets include carbs, which are essentially carbon atoms, which are a significant source of energy. Carbon is useful for many industries for example, it is used to make jewellery, paints and inks, batteries, graphite is used as lead, carbon nanotubes are used in electronics, steel, and carbon is also used in the fertilizer industry. It is typically found as carbon dioxide in the atmospheres of many planets. The atmospheric concentration of carbon dioxide on Earth is approximately 390 parts per million and is increasing. It can also be found in fossilized remains, such as hydrocarbons (natural gas, crude oil, oil shales, coal) and carbonates (chalk, limestone, dolomite). We encounter several terms linked to carbon on a daily basis that require a deep comprehension. This article discusses a few of these terms that can be helpful to farmers, academicians and the scientific community.

1. **Carbon:** The name 'carbon' comes from the Latin word 'carbo', which implies charcoal **(Toppr, 2024).** Roughly 0.025 % of the crust of Earth is composed of carbon. It is the 15th most abundant element in the Earth's crust, the fourth most plentiful element in the cosmos by mass (after hydrogen, helium, and oxygen), and the second most abundant element in the human body by mass (approximately 18.5%) after oxygen **(Royal Society of Chemistry, 2024).** Carbon is a non-metal and is represented by the symbol C. The ability of a carbon atom to form nearly infinitely strong bonds with other carbon atoms makes it special and unique despite its tiny size. Diamond and graphite are the two main forms of carbon allotropes, and they have nearly opposite physical characteristics but both are insoluble in water.
2. **Carbon black:** In its purest state, carbon black is a fine black powder that is primarily made of elemental carbon. It is lightweight and also referred to by its subtypes, acetylene black, channel black, furnace black, lamp black, and thermal black. This substance is created when coal tar, vegetable matter, or petroleum products (such as fuel oil, fluid catalytic cracking tar, and ethylene cracking) are partially burned at high temperatures under limited air conditions. Although carbon black is primarily used to reinforce rubber in tyres, it can also be utilized in a range of rubber, plastic, printing, and coating applications as a pigment, UV stabilizer, and conductive or insulating agent. Inhaling particulates of carbon black can aggravate lung irritation, induce coughing, and worsen lung diseases. Exposure to it may also cause irritation to the throat, nose, and eyes.

3. **Activated carbon:** Activated carbon functions as an adsorption medium, adsorbing organic molecules in its micropores. It is created through the high-temperature, oxygen-free heating of carbonaceous materials like coal, wood, peat, and coconut shells. It is called "activated carbon" because it is activated through chemical or thermal treatments that increase its adsorption capability. While activated carbon and charcoal share many similarities, they also differ significantly. Activated carbon can be produced from wood, peat, nutshells, coconut husks, lignite, coal, coir, or petroleum pitch, although charcoal is often created from wood. Applications for activated carbon include ground and municipal water treatment, power plant and landfill gas emissions, precious metal recovery, and drinking water purification for both industrial and domestic use.
4. **Carbon nanotubes:** A carbon nanotube is an allotrope of carbon that has been created by humans and has the appearance of a tube made of carbon atoms. Even though they are quite sturdy and hard to break, they are nevertheless lightweight. A kind of carbon known as carbon nanotubes (CNTs) has a length of micrometres and a diameter of nanometers (where the length to diameter ratio surpasses 1000). Energy storage, automobile components, sporting goods, water filters, thin-film electronics, coatings, electromagnetic shields, and other products use these nanoparticles.
5. **Subducting carbon:** When an oceanic plate collides with a continental plate and slides beneath it, subduction takes place. Much of the carbon is lost annually into these subduction zones, which has an impact on Earth's atmospheric oxygen and carbon dioxide levels. As it approaches subduction zones, the carbon changes into volcanic gases, fluids, magmas, and diamonds. "Subducting carbon" is the term used to describe carbon that enters subduction zones.
6. **Carbon/ Radiocarbon dating:** It is a technique for estimating the age of ancient material (such a specimen from an archaeology or paleontology study) by looking at its carbon content. Carbon-14, a rare type of carbon, is used to determine the age of fossils, bones, and other materials. To determine how long, the aforementioned organic material will last, the release of this carbon-14 is tracked.
7. **Carbonated water:** In many places, it is also referred to as mineral water, seltzer, or seltzer water, particularly in the United States. Other names for it include soda water, bubbly water, sparkling water, fizzy water, club soda and water with gas. It is the water that has carbon dioxide gas dissolved in it, either naturally occurring due to geological processes or purposefully injected under pressure. Small bubbles are created by carbonation, which gives the water an effervescent appearance.
8. **Carbon cycle:** It the process by which carbon atoms or compounds continually transfer between the biosphere, geosphere, pedosphere, hydrosphere, and atmosphere of the earth. When animals die out, volcanoes erupt, flames burn and fossil fuels are consumed, carbon is released back into the atmosphere. When it comes to the ocean, carbon is either permanently deposited in the ocean's depths or is constantly exchanged between the surface waters and the atmosphere. The following are the key steps in the carbon cycle process: 1. Plants take up atmospheric carbon for photosynthesis. 2. After that, animals eat these plants, carbon bioaccumulates within their bodies. 3. When these creatures pass away, the carbon they contain is broken down into fossil fuels and released back into the atmosphere. 4. Following that, mankind employs these fossil fuels for a variety of purposes.
9. **Carbon credit:** Climate change and global warming are becoming more common, and they are causing significant financial losses. International accords have imposed limits on the quantity of greenhouse gas emissions that nations are permitted to create. “Carbon credits are permits that let a nation or organization emit a specific amount of carbon dioxide”. One carbon credit permits the release of one tonne of carbon dioxide or an

equivalent quantity of other greenhouse gases into the atmosphere. Companies that emit more than their allotted amount of carbon dioxide must purchase credits; those that emit less can sell the credits they still have. These credits can be bought and sold at the current price in foreign markets, or they can be traded amongst companies. Carbon credits enable businesses to fund initiatives that keep global climate targets within reach. Reforestation, renewable energy construction, carbon-storing agriculture techniques, and landfill management are a few typical examples of initiatives. They can also assist ordinary landowners and farmers around the world supplement their income. Therefore, carbon credits are a means of combating climate change as well as a catalyst for global economic development. According to **CoinGecko (2024)**, the current value of one Carbon Credit (CCT) in Indian Rupee (INR) is around ₹18.91.

10. **Carbon Tax:** This is also known as the CO_2 tax or carbon-di-oxide tax. "It's a type of pollution tax that imposes a fee on the extraction, transportation, or consumption of fossil fuels according to the amount of carbon dioxide released during combustion." New Zealand is the pioneering country to impose a carbon tax, which is paid for by industry. By essentially raising the cost of fossil fuels, it aims to lower GHG emissions. This tax not only deters pollution, but also offers incentives for the development, financing, and implementation of low-emission and more efficient alternatives. The ultimate purpose of a carbon tax is to limit or eliminate the usage of fossil fuels.
11. **Carbon pricing:** Through the imposition of an emission tax and/or the provision of an incentive for reducing emissions, carbon pricing regulates GHG emissions. It is a tactic that evaluates the external costs of greenhouse gas emissions (costs that the general public bears, like property loss from sea level rise, crop damage from altered rainfall patterns, or medical expenses from heat waves and droughts), and places that cost back at the source by putting a price on the CO_2 emitted. This way it shifts accountability for emissions and their effects to the emitters. Carbon pricing raises the price of carbon-emitting products and activities, which incentivizes manufacturers and consumers to invest in emission-reducing technology. Currently, over 8 gigatons of CO_2e, i.e. 15% of global GHG emissions, are covered by different carbon pricing initiatives **(United Nations Climate Change, 2024)**.
12. **Carbon sequestration:** It is the practice of removing carbon dioxide (CO_2) from the atmosphere and storing it in plants, soils, geologic formations, and the ocean for extended periods. It occurs naturally and as a result of human activity. Carbon sinks are repositories of carbon that trap and prevent it from entering the Earth's atmosphere. Reforestation or forest regrowth, for instance, act as carbon sinks while deforestation is a source of carbon emissions. Geological sequestration, technological sequestration, and biological sequestration are the three forms of carbon sequestration. 1. Biological carbon sequestration, or biosequestration, stores carbon dioxide in soils, seas, and vegetation like grasslands and forests. 2. The process of storing CO_2 in subsurface geologic formations, or rocks, is known as geological carbon sequestration. 3. The goal of technological carbon sequestration is to extract and store carbon from the atmosphere through the application of cutting-edge technologies.
13. **Carbon capture technology:** It is a method of capturing CO_2 and burying it underground. Often called carbon capture and storage (CCS) technology, it is essential to our goal of reaching net zero by 2050. There are two main types of CCS. 1. Biological: this occurs when CO_2 from the atmosphere is taken up by the natural environment (forests and oceans). 2. Artificial or geological: this occurs when CO_2 is removed by the activities carried out by humans and stored in massive underground storage facilities. The scale of biological CCS is significantly greater than that of geological CCS.

14. **Carbon farming:** It is a suite of farming practices intended to store carbon dioxide in the soil, crop roots, wood, and leaves. Plants use photosynthesis to take up CO_2 from the atmosphere and then microbes break down the roots and other components of plant to produce soil carbon. It's fairly comparable to carbon sequestration. A net reduction of carbon in the atmosphere is the ultimate aim of carbon farming. Applying soil amendments (i.e., items added to soils to increase properties like soil fertility) like compost or biochar, agroforestry, conservation tillage, recycling entire orchards, and cover crops are examples of carbon farming approaches. In addition to improving soil water retention and infiltration, amendments that raise soil organic matter also strengthen soil resilience to climate-related shocks including heat waves, droughts, and heavy rains.
15. **Carbon footprint:** It is the total amount of GHGS (including CO_2 and CH_4) produced by our actions. Every day activity we engage in, such as driving a car, consuming processed foods, shipping, using air conditioning in buildings, etc., produces some level of greenhouse gas emissions, and all come together to determine the size of our carbon footprints. Around the world, a person's carbon footprint is closer to 4 tons on average, with the USA having the biggest carbon footprint at 16 tons. To prevent a 2°C increase in global temperatures, the average annual carbon footprint must decrease to less than 2 tons by the year 2050. Transportation, industrial operations, agriculture, livestock production, deforestation, and energy consumption based on fossil fuels are the main causes of carbon footprints. Greater carbon footprints have negative effects on the environment, animals, and human health, and eventually slow down the country's or society's economic progress. We can lower our carbon footprints in a number of ways, such as switching to green energy, adopting the reuse-reduce-recycle thought, purchasing locally produced food, conserving electricity, adjusting the thermostat to 20°C in the winter and 25°C in the summer, and taking alternate modes of transportation (train, bus, bike, and walk).

Conclusion

Carbon is an essential component of our daily lives, and understanding its benefits and accompanying risks is critical for individuals to use it safely. Terminologies related to carbon can occasionally be unclear and need to be clarified. This article will help to bridge the knowledge gap between scientists and the farming community in terms of everyday relevant carbon terminologies. Similarly, farmers can benefit financially from understanding carbon credits and the above-mentioned carbon restoration measures, and scientists can operate more effectively in farmer fields.

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References

1. Royal Society of Chemistry. 2024. Carbon. https://www.rsc.org/periodic-table/element/6/carbon . 01 April, 2024
2. Toppr. 2024. Carbon and its Compounds. https://www.toppr.com/guides/chemistry/carbon-and-its-compounds/carbon/ . 01 April, 2024.
3. CoinGecko. 2024. Convert Carbon Credit to Indian Rupee (CCT to INR). https://www.coingecko.com/en/coins/carbon-credit/inr#:~:text=How%20much%20is%201%20Carbon,INR)%20is%20about%20%E2%82%B918.91 . 01 April, 2024.
4. United Nations Climate Change. 2024. About Carbon Pricing. https://unfccc.int/about-us/regional-collaboration-centres/the-ciaca/about-carbon-pricing#What-does-the-Paris-Agreement-say-on-carbon-pricin . 02 April, 2024.