TRENDS IN AGRICULTURE SCIENCE

Popular Article

Vol.2 Issue 12 December 2023, Page: 1101-1104

Rising carbon dioxide (CO_2) levels are degrading nutritional value of our food

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Abstract

The nutritional value of crops is decreased when atmospheric carbon dioxide (CO_2) levels are high because they adversely affect vital plant nutrients. Concerns are heightened as CO_2 levels rise, affecting both the amount and quality of food, particularly in areas like India that struggle with hunger. Crop production is made more difficult by the complex link between changing soil balance and decreased nutrition. The problem is made worse by changes in soil microbiota and nutrient uptake patterns brought on by CO_2. Notably, the protein, vitamin, and mineral content of rice decreases, which is significant for a population that depends heavily on it. Diversified crops with improved nutrient uptake, supported by governmental incentives, are necessary to address these issues. A promising strategy is embracing diversity through methods like intercropping.

Key words: Elevated CO_2; Crop diversity; Climate change; Nutritional value

Introduction

Elevated atmospheric carbon dioxide (CO_2) levels have a deleterious effect on essential mineral components in plants, lowering the nutritional value of consuming those plants. When exposed to high amounts of carbon dioxide, nearly all C_3 plants those whose first carbon compound contains three carbon atoms-show reductions in nutrients such nitrogen, phosphorus, potassium, iron, zinc, magnesium, and sulphur (Gojon *et al*., 2022). The annual study from NOAA's Global Monitoring Lab estimates that atmospheric carbon dioxide levels are currently 50 per cent greater than they were in the pre-industrial era. The average worldwide carbon dioxide level reached a new record high of 417.06 parts per million in 2022. Carbon dioxide is one of the most important greenhouse gases, despite being a crucial resource for plants. The majority of plants on earth, including grains like wheat, rice, barley, and oats, use the C_3 pathway, therefore it raised concerns about how further rising carbon dioxide levels would affect both the quantity and quality of food produced.

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Published: 28 Dec 2023

The worst effects of human activity both above and below are felt by crops

Climate change and its effects on crops' nutritional content have been the subject of numerous studies, and given India's challenges in meeting its food and nutrition needs, the conversation on this subject is now more important than ever. India placed 107 out of 121 nations in the Global Hunger Index (GHI) 2022, and its hunger problem has been classified as serious. The highest child wasting rate (children who are too thin for their height) in the world, according to GHI 2022, is found in India. According to a report in the BMJ Global Health in 2022, severe acute malnutrition has sharply grown in India over the previous 20 years. Healthy eating habits must be established early, and getting the proper amount of nourishment at the right time can make all the difference.

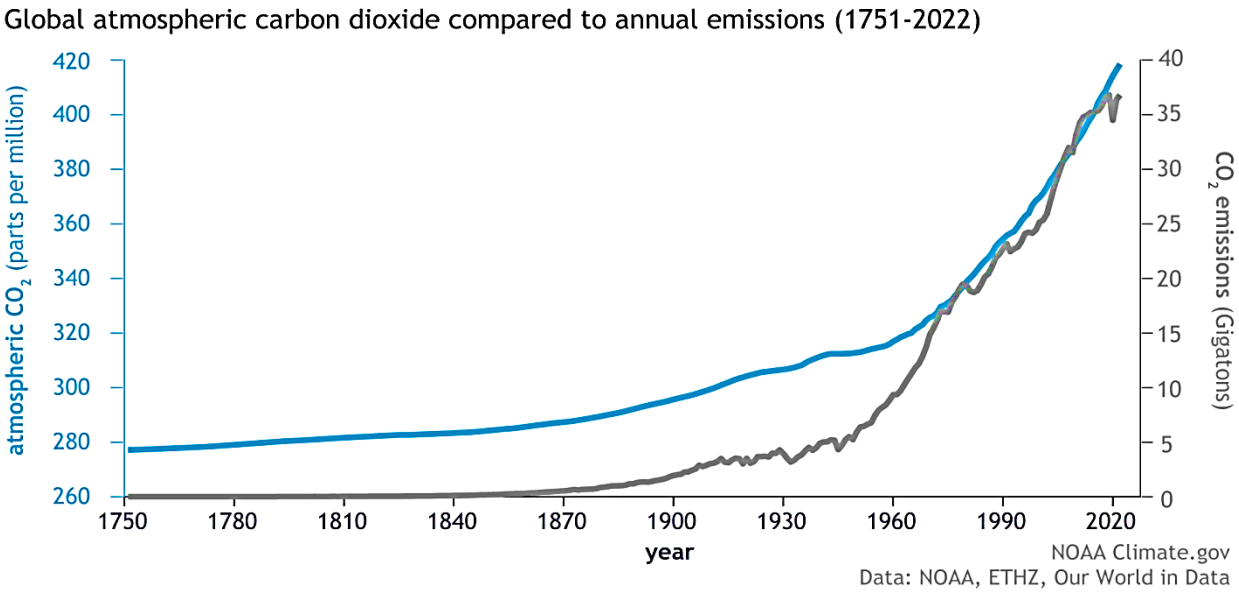

Fig. 1: Since the beginning of the Industrial Revolution in 1750, human emissions (grey line) and atmospheric carbon dioxide concentration (blue line) have both increased.

The problem is complicated by the fact that, in addition to altering the balance of the soil due to higher carbon dioxide levels, there are also nutritional issues that must be addressed (Bai *et al.,* 2019). Increased photosynthesis, which results in higher biomass when plants are exposed to more carbon dioxide, occurs when this happens. Plants attempt to nutrient-drain additional soil from the soil to meet the new need. Additionally, the carbon dioxide impacts the micro-flora of the soil, which in turn affects the rates of decomposition in the soil and the nutrients that are available to plants. Without the input of outside nutrients, the vicious cycle makes it challenging to grow crops. According to Zhu *et al*. (2018), increased atmospheric carbon dioxide affects protein of rice grains and vitamin content in addition to micronutrients. The study discovered that, in addition to protein, zinc, and iron, carbon dioxide levels also contribute to a drop in the vitamins B_1, B_2, B_5, and B_9. Given that rice is the main food supply for more than half of the

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world's population, it can be difficult to determine the precise health effects, although these inadequacies can have serious negative effects.

Fig. 2: Elevated carbon dioxide levels added to the scenario will further complicate matters, leading to a reduction in mineral, protein, and vitamin content.

The diversity of crops is essential for managing nutrition issues. While there are many possible approaches to resolving this complex problem, producing plants with improved soil nutrient absorption capacity together with maximum yield production is one practical way to get ready for a future with nutritional uncertainty. The cultivation of crop types with higher nutritional contents must be encouraged at the policy level. This financial incentive promotes the use of such nutrient-rich crop lines. Within the plants we eat, the natural environment offers a wide range of genetic variety. In order to treat nutritional deficits, it is critical to promote diversity in both temporal dimensions, such as crop rotation, and spatial factors, such as intercropping different crop lines in the same region.

Conclusion

The global worry over diminishing food quality and nutritional content grows in light of rising atmospheric carbon dioxide levels and their detrimental impact on vital plant nutrients. The frightening figures on hunger and malnutrition, especially in areas like India, highlight the urgency of addressing this issue. The complex interplay between altered soil balance and decreased nutritional content creates a considerable barrier for crop development as CO_2 levels rise. It is urgently necessary to address the complex interaction between atmospheric CO_2 and crop health, which is demonstrated by decreased protein, vitamin, and mineral levels, particularly in essential staples like rice.

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Embracing crop diversity appears as a key tactic to address these issues. Prioritising plant types with enhanced nutrient absorption capacities and optimal yields emerges as a feasible strategy to navigate a nutritionally uncertain future among the complexity of solutions. Crops with improved nutritional profiles are supported by policy, which encourages the growth of nutrient-rich cultivars. Additionally, encouraging diversity through strategies like intercropping and crop rotation has promise in resolving these inadequacies.

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