CORPUS PUBLISHERS

Archives of Agriculture Research and Technology (AART)

ISSN: 2832-8639

Volume 5 Issue 1, 2024

Article Information

Received date : May 26, 2024

Published date: May 31, 2024

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DOI: 10.54026/AART/1069

Keywords

Agrobiology; Allelopathy; Allelochemicals; Conductance

Letter to Editor

Isotopic Effects of Allelopathy in Agrophytocoenoses

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Letter to Editor

The conceptual basis for methods for analyzing the biological isotope of carbon in problems of agrobiology and soil science (when considering soil as an "exchanger" and a bioinert body) is the idea of biological fractionation of isotopes, developed in the works of Academician EM. Galimov (and others). During photosynthesis, depletion of the 13C isotope is realized, and land plants are depleted in 13C to a greater extent than marine plankton, and in plants with different types of photosynthesis (C3 carbon fixation and C4 carbon fixation, also known as the Hatch–Slack pathway), the isotopic composition differs in different biochemical conditions. constituents (lipids, proteins, carbohydrates, etc.). All this is encyclopedic textbook information that does not require addition - with the exception of the latest information on the dependence of the isotopic composition of plants on the spectral composition of light and irradiation regimes during photosynthesis (from 7 to 19 times to air, which is exotic and requires verification) [1]. Based on this, in multi-species communities (agrophytocenoses) it is possible to correlate photosynthetic productivity and species composition (which are not equivalently sensitive to different spectral ranges of plants), including the migration of certain isotopes between species in the mechanisms of allelopathy in agrophytocenoses, including with the change of seasons and crop rotation in different phenospectral conditions, characterized by different effective temperatures and spectrozonal efficiencies (irradiance).

The isotope effects of allelopathy have been studied repeatedly since the 1990s. [2-7], both in laboratory conditions or in isolated experimental fields, and in natural conditions, however, firstly, we analyzed mainly weeds that do not represent agrobiological value (*Leptochloa spp., Echinochloa crus-galli, Lolium perenne L.*; excluding, perhaps, only *Rumex acetosa*, *Oryza sativa* and a number of other cultivated crops), and, secondly, the spectral composition, phenospectral parameters of growth and isotope exchange with the soil were not taken into account. , also involved in isotope fractionation [8-10]. At the same time, there are mass spectrometric methods for monitoring the isotopy of gases, allelochemicals and partially ordered soil media (including the so-called complex mixtures), including in the mode of (semi) automated permanent monitoring along with measurement of parameters environment with which the plant exchanges isotopes. For example, there are time-resolved mass spectrometry methods used in the analysis of plant growth and development [11-13], tracking isotopy and allowing one to track a series of transitions between phases of plant ontogenesis, characterized by the emission of different allelochemicals and chemoattractants, causing different effects in agrophytocenosis. With their help, the isotope effect can be compared to phenospectral stages and complex ontogenetic physiological changes in plants, since, as stated in the seminal work on multiparametric (multifacet) analytics of allelopathy, "leaf water potential, turgor pressure, conductance, or a change in tissue carbon isotope ratio [14] are equivalent indicators of bioresponse.

References

1. Kuleshova TE, Pavlova ES, Gall NR (2020) Fractionation of carbon isotopes 13C/12C from atmospheric carbon dioxide into photosynthetic products in plant leaves depending on the spectral characteristics of the light environment. Letters to the Journal of Technical Physics 46(16): 19-22.
2. Peñuelas J, Ribas CM, Giles L (1996) Effects of allelochemicals on plant respiration and oxygen isotope fractionation by the alternative oxidase. Journal of Chemical Ecology 22(4): 801-805.
3. Gealy DR, Fischer AJ (2010) ^{13}C discrimination: a stable isotope method to quantify root interactions between C_3 rice *(Oryza sativa)* and C4 barnyardgrass *(Echinochloa crus-galli)* in flooded fields. WS, 58(3): 359-368.
4. Hussain MI, Reigosa MJ (2012) Seedling growth, leaf water status and signature of stable carbon isotopes in C_3 perennials exposed to natural phytochemicals. Australian Journal of Botany 60(8): 676-684.
5. Gealy D, Moldenhauer K, Duke S (2013) Root distribution and potential interactions between allelopathic rice, sprangletop *(Leptochloa spp.)*, and barnyardgrass *(Echinochloa crusgalli)* based on ^{13}C isotope discrimination analysis. Journal of chemical ecology 39(2): 186-203.
6. Hussain MI, Reigosa MJ (2017) Evaluation of photosynthetic performance and carbon isotope discrimination in perennial ryegrass *(Lolium perenne L.)* under allelochemicals stress. Ecotoxicology 26(5): 613-624.
7. Hussain MI, Reigosa MJ, Muscolo A (2018) Carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope composition provide new insights into phenotypic plasticity in broad leaf weed Rumex acetosa under allelochemical stress. Molecules 23(10): 2449.
8. Boström B, Comstedt D, Ekblad A (2007) Isotope fractionation and 13C enrichment in soil profiles during the decomposition of soil organic matter. Oecologia 153(1): 89-98.
9. Lewicka SD, Dyckmans J, Kaiser J, Marca A, Augustin J, et al. (2016) Oxygen isotope fractionation during N_2O production by soil denitrification. Biogeosciences 13(4): 1129-1144.
10. Gaj M, Kaufhold S, Koeniger P, Beyer M, Weiler M, et al. (2017) Mineral mediated isotope fractionation of soil water. Rapid Communications in Mass Spectrometry 31(3): 269-280.
11. Gradov O (2014) Novel phenospectral auxanometry using complexation of optical spectroscopy and chromatographic auxanometry or GC-MS-auxanometry in forest plant species vegetation phenological monitoring based on gas & flavor chemistry principles. Int Journ Green Herb Chem Ser A 3(2): 555–579.
12. Gradov OV (2015) Chromato-auxanometry and chromato-mass auxanometry in phenological stage monitoring of forest species based on flow and gas chemical principles with automatic dynamic identification of patterns. News of higher educational institutions. Forest Journal 347: 34–66.

13. Gradov OV (2016) Chromato-auxanometry and chromato-mass auxanometry in phenological stage monitoring of forest species based on flow and gas chemical principles with automatic dynamic identification of patterns. Abstract journal VINITI ser. Biology.

14. Ambika SR (2013) Multifaceted attributes of allelochemicals and mechanism of allelopathy. In: Allelopathy. Springer, Berlin, Heidelberg. pp. 389-405.