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Grain Crops Bio stimulation for Sustainable Agriculture: *The Successful Humic Example*

Opinion
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Opinion

Sustainable practices have become a major goal in agriculture to boost crop productivity, reduce yield gaps, and safeguard the environment. In recent years, bio stimulants have gained interest as innovative inputs that could foster plant growth and yield, including in sub-optimal cropping conditions such as drought. Bio stimulants are known as "any substance or microorganism that, when applied to seeds, plants, or the rhizosphere, stimulates natural processes to enhance or benefit nutrient uptake, nutrient efficiency, tolerance to abiotic stress, or crop quality and yield" [1]. Humic bio stimulants (HB) have been used for decades in applications to the seeds, soil, or leaves on horticultural crops but less to field grain crops to stimulate growth, nutrient absorption, product quality, yield, and tolerance to abiotic stress. The application of vermicompost humic extracts has resulted in the activation of the antioxidant enzymatic function and the increase of ROS-scavenging enzymes to block toxic oxygen radicals produced in plants under stress [2-4]. The effects of humic, measured by bioassays, immunological tools, and molecular genomics under controlled conditions, are explained by signaling endogenous genes responsible for the biosynthesis of protective compounds, attenuating oxidation processes caused by water stress and high temperature [5,6]. Dry weights of roots of different plant species increased 22% in response to the exogenous application of HB [7]. Although foliar applications of HB are sometimes adverse [8,9] they have been successful in inducing higher yields in garlic, tomato, and asparagus [10] and legume crops such as dry beans [11] mung-bean [12] soybean [13] and cowpeas [14]. However, in the literature, there is a paucity of field results on the efficacy of humic bio stimulants for multiple locations and over several years on grain crops [15]. The use of HB as foliar applications is not yet part of agronomic management and is still not considered an effective way to reduce the field food crops yield gap and/or integrate it into other practices such as double-cropping and irrigation. Humic bio stimulant foliar-field applied in conjunction (tank mix) with herbicides, fungicides, and insecticides continue to be studied given a growing market and expectations in practical methods that would allow their incorporation but after required extensive testing for grain crops sustainable management. Recently, promising yield responses from on-farm trials (OFT) and a single humic terrestrial application were obtained in soybeans (Figure 1) [16]. These results are coincident with those reported with field strips in maize [15] and replicated blocks in wheat [18] and barley [19]. Rice yield increase and positive economic returns have been obtained on-farm trials with a single airplane spraying on rice (Figure 2) [17].

It is estimated by FAO that by 2050 the world population will exceed 9.7 billion people. Thus, the total global food demand is expected to increase by around 50%–60%. In this context, it is necessary to significantly increase sustainable agricultural production, where more agricultural land, fertilizer, water, and high-yielding crops will be used to ensure the food supply. Several factors may contribute to yield gaps in grain crops and are multicausal, including nutrient deficiencies and imbalances, water stress, flooding, suboptimal planting, soil problems, weed pressures, insect damage, diseases, lodging, and inferior seed quality. To be implemented as an agricultural practice, field foliar application of bio stimulants on grain crops requires long-term validation at the farm level. This can be pursued as an extensive and low-cost practice to be adopted by farmers after proper demonstration and, at the same time, technology transfer. On it, it is auspicious to count with multiple years and location on-farm trials and the statistical-graphic method on yield responses [20-22] successfully probed in soybean [16] and rice [17] that can be used for evaluation, farm testing-transfer, and registration with other bio inputs as well. The results confirm that this technology can be part of agronomic management in the agricultural sector and holds promise for bridging yield gaps. Further agricultural research targeting physiological mechanisms and induction of gene signaling, along with assessments of parameters like leaf chlorophyll evolution and nitrogen dynamics during reproductive phases, promise deeper insights into the underlying mechanisms driving the response to humic bio stimulants when applied on grain crops.

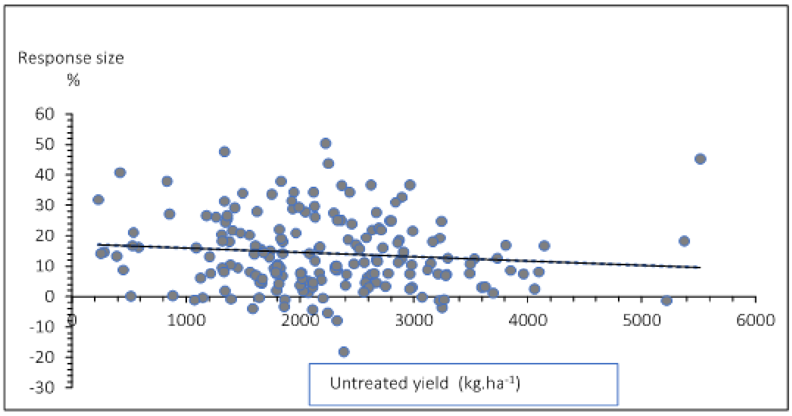

Figure 1: Soybean yield responses (%) over the untreated control when a humic biostimulant PromoBacter (R) was applied at R3-R4 stage at on-farm trials conducted in Uruguay from 2014 to 2023; mean=14.22%; 12.50-15.93 CI (95%); y=-0.0014x +17.32; R2=0.0118; P-value: 0.145; n=180. Source [16].

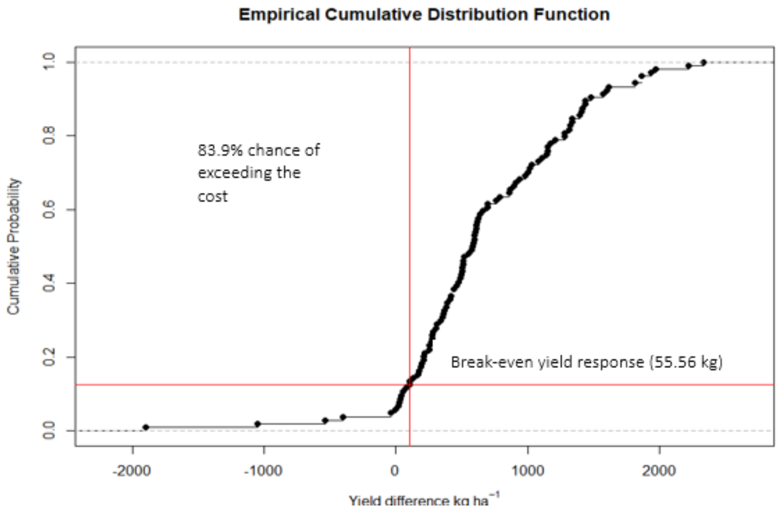

Figure 2: Estimated cumulative distribution functions, mean yield responses, and the break-cost even yield from rice on-farm trials sprayed with a single humic PromoBacter (R) application. Untreated mean yields (t ha-1): 8.716; Yield mean response to humic treatment (%): 7.56; Net economic return to the humic application (US$ ha-1): 164.70; n=77. Source [17].

References

1. Sible CN, Seebauer JR, Below FE (2021) Plant biostimulants: A categorical review, their implications for row crop production, and relation to soil health indicators. Agronomy 11: 1297.
2. García, AC, Santos LA, Izquierdo FG, Sperandio MVL, Castro RN, et al. (2012) Vermicompost humic acids as an ecological pathway to protect rice plant against oxidative stress. Ecological Engineering 47:203-208.
3. Du Jardin P (2015) Plant biostimulants: Definition, concept, main categories and regulation. Scientia Horticulturae 196:3-14.
4. Zandonadi DB, Santos MP, Caixeta LS, Marinho EB, Peres LEP (2016) Plant proton pumps as markers of biostimulant action. Scientia Agricola 73: 24-28.
5. Yakhin OI, Lubyanov AA, Yakhin IA, Brown PH (2017) Biostimulants in plant science: A global perspective. Frontiers in Plant Science 7: 2049.
6. Fleming TR, Fleming CC, Levy CC, Repiso C, Hennequar F (2019) Biostimulants enhance growth and drought tolerance in Arabidopsis thaliana and exhibit chemical priming action. Annual Applied Biology 174: 153-165.
7. Rose MT, Patti AF, Little KR, Brown AL, Jackson WR, et al. (2014) A meta-analysis and review of plant -growth response to humic substances: practical implications for agriculture. Advances in Agronomy 124: 37-89.
8. de Santiago A, Exposito A, Quintero JM, Carmona E, Delgado A (2010) Adverse effects of humic substances from different origins on lupin as related to iron sources. Journal of Plant Nutrition 33: 143-156.
9. Hartz TK, Bottoms TG (2010) Humic substances generally ineffective in improving vegetable crop nutrient uptake or productivity. HortScience 45: 906-910.
10. Jindo K, Olivares FL, Malcher DJDP, Sánchez-Monedero MA, Kempenaar C, et al. (2020) From lab to field: role of humic substances under open-field and greenhouse conditions as biostimulant and biocontrol agent. Frontiers in Plant Science 11: 426.
11. Kaya M, Atak M, Khawar KM, Çiftçi CY, Ozcan S (2005) Effect of pre-sowing seed treatment with zinc and foliar spray of humic acids on yield of common bean (*Phaseolus vulgaris* L.) International Journal of Agricultural Biology 7: 875-878.
12. Waqas M, Ahmad B, Arif M, Munsif F, Khan AL, et al. (2014) Evaluation of humic acid application methods for yield and yield components of mungbean. American Journal of Plant Science 5: 2269-2276.
13. Prado M, Weber O, Moraes M, Santos C, Santos Tunes M, et al. (2016) Humic substances on soybeans grown under water stress. Communications in Soil Science and Plant Analysis 47: 2405-2413.
14. El-Hefny EM (2010) Effect of saline irrigation water and humic acid application on growth and productivity of two cultivars of cowpea (*Vigna unguiculata* L. Walp). Australian Journal of Basic Applied Science 4: 6154-6168.
15. Olk DC, Dinnes DL, Callaway CR (2022) Maize growth responses to a humic product in Iowa production fields: An extensive approach. Front Plant Sci 12, 778603.

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16. Izquierdo J, Schwember AR, Arriagada O, García-Pintos G (2023) On-farm soybean response to a field foliar applied humic biostimulant at differing cropping environments of Uruguay. Chil J Agric Res 83(5).

17. Izquierdo J, Arriagada O, García-Pintos G, Ortiz R, García-Pintos M, et al. (2024) On-farm foliar application of a humic biostimulant increases the yield of rice. Agronomy Journal 1-13.

18. Pacuta V, Rašovský M, Michalska-Klimczak B, Wyszynski Z (2021) Grain yield and quality traits of durum wheat (*Triticum durum* Desf.) treated with seaweed- and humic acid-based biostimulants. Agronomy 11: 1270.

19. Abdel-Ati AS, Saleh NA, Rahuma M (2023) Effect of humic acid and seaweed extract rates on yield and yield components of barley (*Hordeum vulgare* L.). Alexandria Sci Exchange J 44: 459-463.

20. Laurent A, Kyveryga P, Makowski D, Migue F (2019) A framework for visualization and analysis of agronomic field trials from on-farm research networks. Agronomy J 111: 2712-2723.

21. Laurent A, Lyu X, Kyveryga P, Makowski D, Hofmann H, et al. (2020) Interactive web-based data visualization and analysis tool for synthesizing on-farm research networks data. Res Synth Methods 12: 62-73.

22. Laurent A, Miguez F, Kyveryga P, Makowski D (2020) Going beyond mean effect size: presenting prediction intervals for on-farm network trial analyses. Eur J Agron 120: 126127.

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