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Opinion

Green Algal Pesticide–Fertilizer for Sustainable Agriculture and Food Security

Altaf AR[1]*, Razzaq S[2], Raza S[3], Mengal MA[4], Bakhsh G[5], Raza AI[6] and Saleem M[7]

[1]College of Engineering, Huazhong Agricultural University, China

[2]State Key Laboratory of Eco-hydraulics in Northwest Arid Region of China, Xi'an University of Technology, China

[3]School of Economics and Agri-economics, Pir Mehar Ali Shah Arid Agriculture University Rawalpindi, Pakistan

[4]Training and Publicity, Agriculture Extension, Pakistan

[5]Training and Publicity, Agriculture Extension, Pakistan

[6]MARS lab School of Computer Science, Northwest Polytechnical University, China

[7]Soil conservation Forest and Wildlife department, Pakistan

ISSN: 2637-7802

***Corresponding author:** Adnan Raza Altaf, 1School of Environmental Science and Engineering, Shandong University, Qingdao 266237, Shandong, China.

Submission: March 26, 2022
Published: April 19, 2022

Volume 2 - Issue 3

How to cite this article: Altaf AR*, Razzaq S, Raza S, Mengal MA, Bakhsh G, et al. Green Algal Pesticide–Fertilizer for Sustainable Agriculture and Food Security. Biodiversity Online J. 2(3). BOJ. 000535. 2022.

Opinion

World population expansion and climate change have posed greater challenges to food production. It is believed that food production would need to be raised by 100-110% in 2050, higher than the 70% expected in the current scenario [1]. As a result, more herbicides and fertilizers are being utilized in contemporary agriculture to improve crop yields. However, the frequent application of these agrochemicals offers several ecological losses and health risks [2]. The severe ecological losses and inefficiency in food production continue to confound efforts in achieving and maintaining food security [3]. Therefore, developing and exploring smart and eco-friendly strategies without compromising crop yields and food security is an exciting new futuristic research direction in this area. To date, various advanced techniques have been developed, including nanotechnology and slow and controlled release technology [4]. Smart nanoparticle (NPs) based technologies are great appeal since these strategies respond to a variety of stimuli to achieve controlled release of agrochemicals. These techniques can improve the usage efficiency of the active ingredients and minimize their application rates and overspills [5,6]. However, most of these traditional controlled–release materials have limitations owing to their single purpose application (either fertilizer or pesticide), expensive and non-biodegradable chemicals, and unsustainable supply of agrochemicals [7]. Therefore, the combination of low-cost pesticide-fertilizer, which can safely realize the integration of pest control and nutrient supply, is highly desired.

Algae is a large and diverse group of photosynthetic eukaryotic organisms that exist in both marine and freshwater environments, with similar photosynthetic mechanisms to terrestrial plants. As for biomass, they constitute the world's largest group of primary producers, with photosynthesis accounting for at least 32% of the world's total. Enteromorpha (seaweed

algae) has good research prospects in terms of resource utilization in food, medicine, cosmetics, agriculture, biofuel, etc. [8]. Normally, the Enteromorpha are directly burnt as fuel or employed to prepare bio-oil and different chemicals by pyrolysis. Meanwhile, the pyrolysis process produces a large amount of Enteromorpha-Biochar (EBC), which causes secondary solid waste pollution. This massive solid waste should need to be managed appropriately. To overcome this serious solid waste pollution, EBC can be recycled as an effective pesticide–fertilizer encapsulating agent owing to its multi features including, permanent porosity, hydrophobicity, biodegradability, and eco-environment friendly. Since Enteromorpha are genetically resistant green plants and rich in bioactive and bio-repellent materials [9,10]. Thus, can be use as biofertilizer and biopesticide. In view of the above discussions, it is advised to utilize this abundant biomass resource for all in-one combination strategy for fabricating a smart controlled-release system to achieve synergistic effects of weeding and insecticide and nutrient supply. (Figure 1) describes the complete proposed synthesis and multifunction of algal pesticide-fertilizer on pesticides and nutrients supply. We believe the combination of green agrochemical innovation technology will show great potential in future sustainable and environment friendly agriculture.

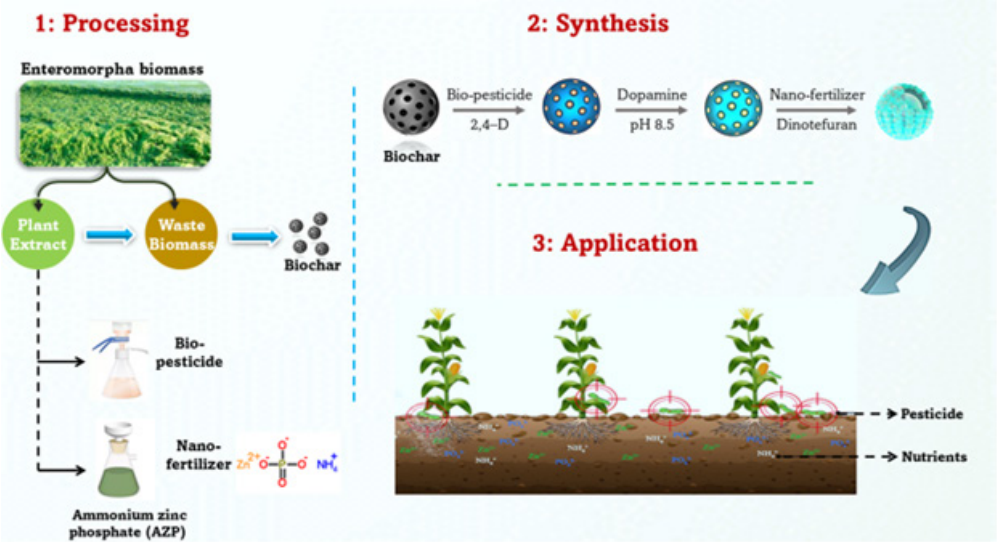

Figure 1: schematic diagram of green algal pesticide-fertilizer, synthesis and its application. dinotefuran a neonicotinoid insecticide safe to mammal and environment. 2,4-d is a postemergence herbicide.

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