



www.sargood-project.com

Valorization of Sargassum biomass for the production of bio-inputs for Agriculture



Jayaraj Jayaraman (Jaya)

Professor of Biotechnology and Plant Microbiology

PI: Plant-Microbe-Biotech Research Group, Dept. of Life Sciences

Faculty of Science & Tech. The University of the West Indies, St. Augustine, Trinidad

jayauwi@gmail.com

Webinar on "Collection and valorization of Sargassum in the Caribbean: issues and prospects", 07 April 2022



Introduction and Rationale

- The flow of Sargassum is becoming a serious environmental problem all over the Caribbean islands.
- In Guadeloupe alone, around 80000 tons of seaweed are stranded during the season.
- A similar situation is seen around the entire Caribbean region.
- Recovery processes are highly sought because 90% of the collected algae are currently stored without proper use or recovery.

- The lack of research initiatives necessitates a more in-depth study targeted at innovative applications and their development.
- Sargassum biomass valorization must meet diverse needs including environmental, health and economic purposes.
- The purposes include use for, agricultural, construction, engineering, chemical, biological, environmental, feed and health product development.

Documented effects of Seaweed products usage

Improved nutritional strategies

Improved water efficiency



Improved disease management

Improved soil fertility

(Jayaraj & Ali, 2015)

Documented effects of Seaweed products on plants



Effects:

- Improved root and shoot growth
- Higher flowering and fruit set
- Increased yield
- Increased tolerance to biotic and abiotic stresses

Mechanisms:

- Modulation of phytohormones
- Increased photosynthetic efficiency
- Delayed senescence
- Upregulation of genes of various metabolic pathways
- Enhanced microbiome dynamics and activities
- Improved soil qualities

SWE improved plant growth

Tomato

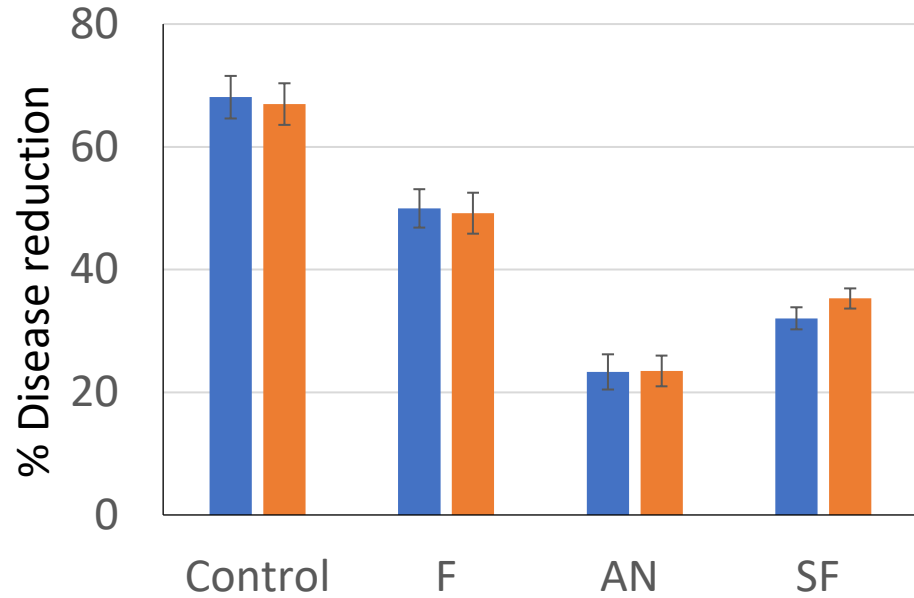
Treatments	Plant height (cm)	Leaf Number	Leaflet weight (g)	Stem weight (g)	Root weight (g)
SF	128.44 b	59.80 c	6.65 c	15.83 c	5.32 c
AN	151.68 c	71.64 d	8.18 d	18.44 d	7.57 d
Fungicide	113.08 a	51.62 b	4.56 b	13.51 b	2.72 b
Control	102.56 a	34.80 a	3.76 a	10.62 a	1.81a

Sweet Pepper

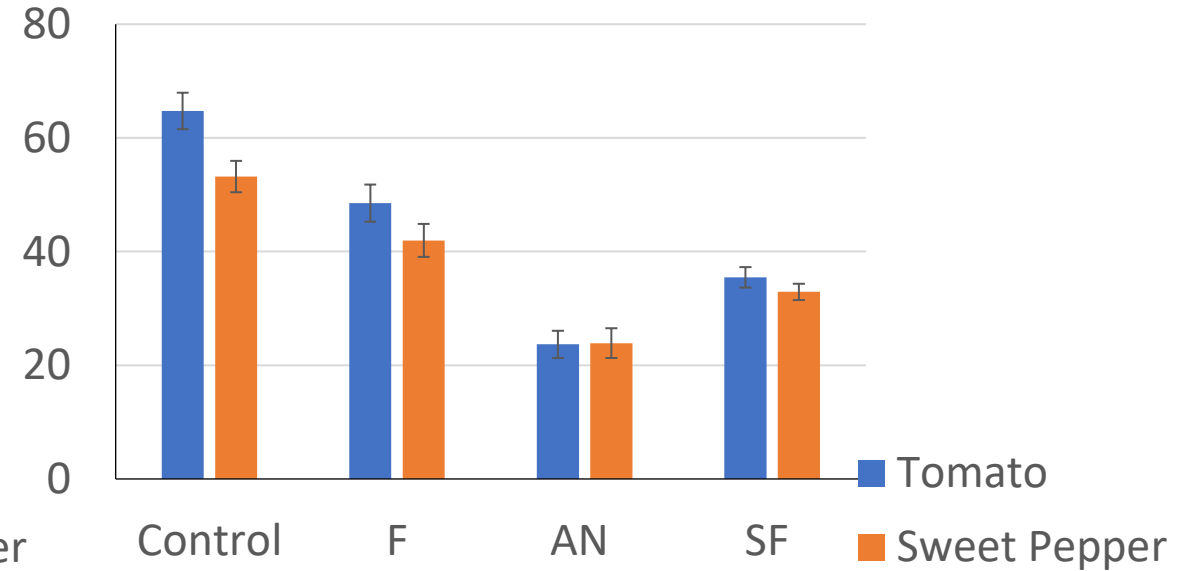
Treatments	Plant height (cm)	Leaf Number	Leaflet weight (g)	Stem weight (g)	Root weight (g)
SF	77.72 c	25.00 c	3.08 c	7.58 b	3.57 b
AN	90.54 d	30.62 d	4.91 d	10.44 c	5.01 c
Fungicide	63.70 b	19.52 b	2.72 b	6.71 a	1.94 a
Control	52.48 a	14.88 a	1.87 a	6.30 a	1.39 a

(Ali et al. 2022)

Greenhouse Disease Severity trials



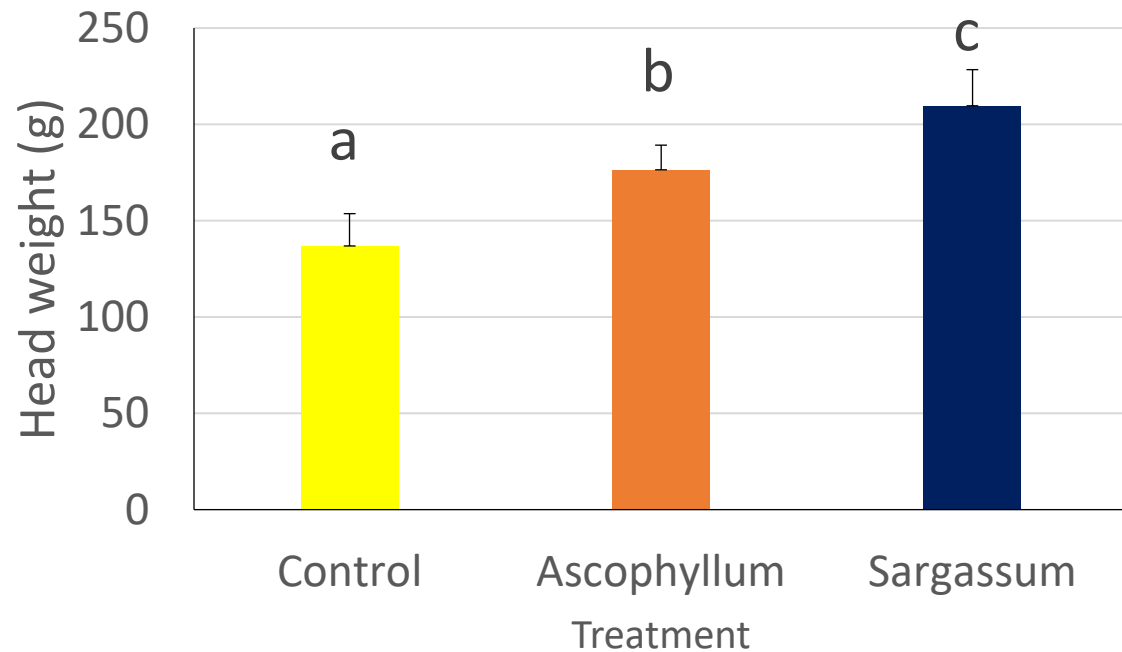
Bacterial spot



Early blight

(Ali et al. 2022)

Effect of SWE on hydroponic- grown lettuce



(Jayaraj et al. 2021)



Overview of the positive effects of seaweed extracts on the plant and soil systems

Improved plant phenotype

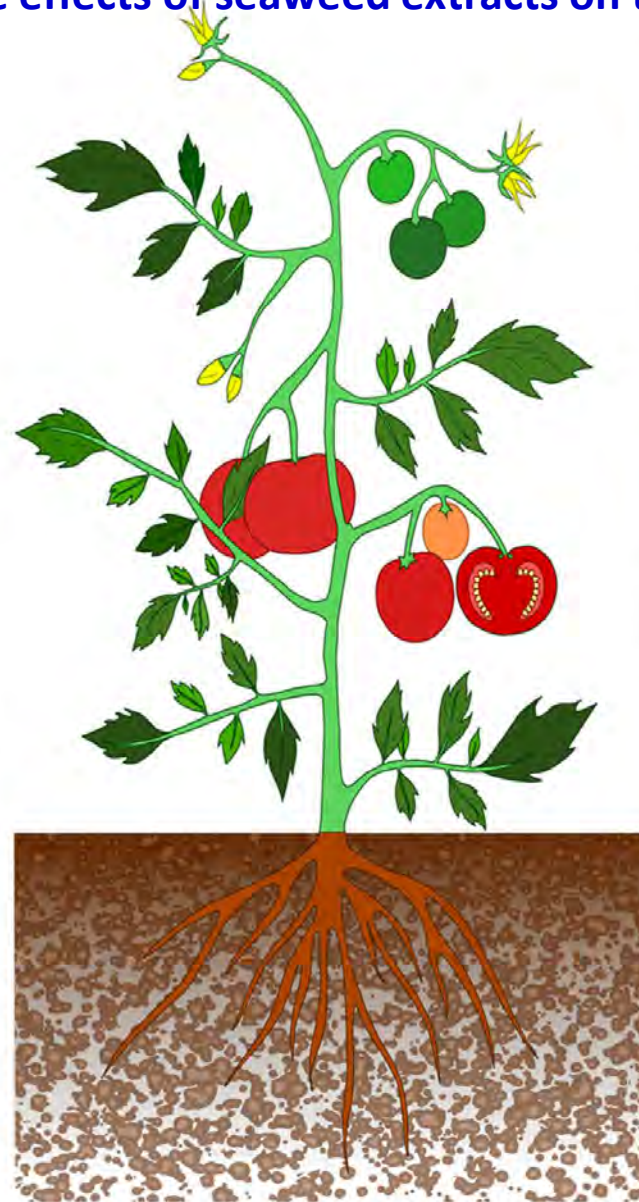
- Starter effect for seedlings
- improved root growth and density
- Increased chlorophyll content, photosynthetic rates & stomatal conductance
- Increased leaf numbers, plant height and vigour
- Higher flower numbers per plant
- Greater fruit set numbers per plant
- Prolonged flowering and bearing

Tolerance effects

- Priming effects/tolerance for biotic stresses
 - insect pests, nematodes
 - microbial pathogens (fungal, bacterial and viral)
- Priming effects/tolerance for abiotic stresses (salinity, drought, freezing)
- Improved resilience to transplantation shock

Microbial restructuring

- Soil crumb structure & aeration improvements
- Increased α & β diversity in soil and root microbes
- increased population of beneficial microbes
- Increased enzymatic activity (hydrogenase, invertase, urease, proteinase, polyphenol oxidase & phosphatase)



Modulated pathways

- Increased expression of phytohormone genes (GA, IAA & CK)
- Modulation of defense signalling pathways (SA, JA & ET)
- Modulation of ABA mediated signalling
- Increased expression of flowering-related genes
- Increased expression of root transporter genes

Produce Quality

- Increased fruit weight and flesh thickness & firmness vibrant colour and higher mineral content
- Increased Vitamin C, TSS, total phenols, anthocyanins, total protein, fructose & sucrose
- Enhanced shelf life, minimized fruit browning and post-harvest infestation

Nutrient Acquisition

- Root structure alteration
- Efficient use of soil water
- Increase micro/macro mineral content in roots and aerial plant tissues
- Rooting promotion in cuttings
- Increased nutrient use efficiency
- Increased uptake of macro and micro nutrients

(Ali et al. 2022)

WP4.4: Developing agriculture-biostimulant products and their evaluation

Activity 1: Extraction of the biomass and development of formulations

Activity 2: Evaluation of biological and stimulatory effects

Activity 3. Impact on the plant, soil, microbes, fauna, ecotoxicology and nutritional quality of the produce

WP5: Use of Sargassum for developing innovative materials

WP5.5: Composting methods for the effective biotransformation of Sargassum residual biomass into value-added agricultural products for soil application

Activity 1. Development of composting methods

Activity 2. Study of microbial mechanisms

Activity 3. Evaluation of bioactivity, biological effects on the plant growth and quality

Activity 4. Study of environmental effects

Activity 5. Technology dissemination and outreach

Project Partners

- The Université des Antilles (UA) – Guadeloupe (Lead)
- The University of the West-Indies (UWI)- Trinidad & Tobago.
- The Universidade de Sao-Paulo (USP) - Brasil.
- The Institut Polytechnique de Toulouse (INPT) - France.
- 100% ZEB, Smart Island - Guadeloupe.

The UWI Team

Name	Expertise	Role/function
Prof. Jayaraj JAYARAMAN	Biotechnology, Microbiology, Bioproducts	PI
Prof. Adesh RAMSUBHAG	Environmental Microbiology, Bioproducts, Antimicrobials	CoPI
Prof. Indar RAMNARINE	Fisheries biology, Marine biodiversity	CoPI
Dr. Nigel JALSA	Biological Chemistry, Natural products	Member
Mr. Omar ALI	Plant-Microbiology, Seaweed-Formulations	Member
Dr. Antonio RAMKISSOON	Antimicrobials, Natural products chemistry	Collaborator
Dr. Chinnaraja CHINNADURAI	Bioinformatics, Biostatistics	Collaborator
Dr. Aidan FARRELL	Plant Physiology, stress physiology	Member
Dr. Azad MOHAMMED	Ecology and toxicology	Member
Prof. Boppana CHOWDARY	Mechanical engineering	Collaborator
Dr. Jeffrey SMITH	Chemical engineering	Collaborator
Dr. Bidyut MOHAPATRA, UWI-Cave Hill	Microbiology	Collaborator
Research associates	Biology, Chemistry and Biotechnology	Researchers
Dr. Chaney St. MARTIN, IICA	Compost technology, Horticulture	Member
Prof. Gomathinayagam SUBRAMANIAN, UG	Biological control, Biofertilizers	Collaborator





THANKS

THE CONSERVATION, FOOD & HEALTH FOUNDATION

