Biological Forum – An International Journal 15(8): 474-477(2023)

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Bioefficacy of Seaweed Coating Formulation on Seed Quality and Biochemical Attributes in Barnyard Millet Var. MDU 1

A. Madhan Kumar[1], K. Sujatha[2*], V. Alex Albert[3], G. Anand[4] and M. L. Mini[5]

[1]Research Scholar, Department of Seed Science and Technology, AC & RI, Madurai (Tamil Nadu), India.
[2]Professor & Head, Department of Seed Science and Technology, AC & RI, Madurai (Tamil Nadu), India.
[3]Associate Professor, Department of Seed Science and Technology, AC & RI, Madurai (Tamil Nadu), India.
[4]Associate Professor, Department of Plant Breeding and Genetics, AC & RI, Madurai (Tamil Nadu), India.
[5]Professor, Department of Biochemistry, AC & RI, Madurai (Tamil Nadu), India.

(Corresponding author: K. Sujatha)*
(Received: 08 June 2023; Revised: 24 June 2023; Accepted: 14 July 2023; Published: 15 August 2023)
(Published by Research Trend)

ABSTRACT: Biological seed coating entails a novel method of seed treatment, involving the application of biological agents on the seed exterior to manage both seed-borne and soil-borne pathogens and also improve the seed vigour. It is a process of applying useful materials to form a continuous layer of thin coating over the seed without altering its shape or size by employing water as the solvent. By encasing the seed within a thin film of biodegradable polymer, the adherence of seed treatment to the seed is improved. The fluctuating and uneven rainfall patterns with changing environmental conditions, negatively impact the establishment of crops and affect the seed quality. In order to address that, an experiment was conducted to study the effect of seaweed coating on physiological seed quality and biochemical parameters in the laboratory of the Department of Seed Science and Technology, AC & RI Madurai during 2023. The treatments encompassing control, T_1-10mlkg^{-1}, T_2-15mlkg^{-1}, T_3-20mlkg^{-1}, T_4-25mlkg^{-1} and T_5-30mlkg^{-1}. Coated seeds were evaluated for seed quality and biochemical parameters. The result of the present investigation revealed that, seeds that are coated @ 20mlkg^{-1} were found to be superior in terms of seed quality and biochemical parameters.

Keywords: Seaweed, coating, formulation, vigour, seed quality and biochemical parameters.

INTRODUCTION

A family of small-seeded grasses known as millets has been domesticated for thousands of years as a staple diet. Barnyard millet provides a crucial source of vitamins and micronutrients that improve nutrition. They were mainly rich in nutrients like iron, calcium, and nutritional elements that can prevent diseases like celiac disease, diabetes, and aneamia. They are referred to as “Nutri cereals” because they contain dense amount of nutrients. Likewise, they may grow in regions that are prone to dryness and are hardy and salinity tolerant. India requested that 2023 be designated as the “International Year of Millets” at the UN General Assembly because of the significance of millets. Today's erratic and uneven rainfall, low-quality seeds, and shifting environmental circumstances have an adverse effect on crop establishment, ultimately causing crop failure. Among the various methods of resolution, seed coating is one of the best approaches to successful crop establishment and improving plant health. Seed coating with chemicals is one of the major threats to organic agriculture (Rathinapriya *et al.*, 2020). There are several biological methods that serve as alternatives to chemical based practices in agriculture. Among these, seaweed plays an important role in offering a sustainable too environmentally friendly approach to farming.

Seaweed is a type of marine algae that grows in coastal and oceanic waters. It is a photosynthetic organism which is known for its rich nutritional profile. Seaweed extract stands as a modern, natural, and organic fertilizer of the new era, comprising potent nutrients. This extract not only fosters vegetative growth and production but also enhances the crops' ability to withstand both biotic and abiotic stress factors Sarita *et al.*, 2021). Natural growth-promoting compounds like auxin, cytokines, and gibberellin found in seaweed extract, which is used to coat the seeds, can help ensure uniform germination and increase the vigour of seedlings in general. Thus, the seed coating is a dependable way of putting exogenous materials, including biopolymers, colorants, bio control agents, and microbes close to seeds that cause germination. By enhancing seed size and performance, it is possible to enhance both yield and seed quality, such as viability and vigour (Afzal *et al.*, 2016). With this approach, research experiments were conducted to identify the effect of seaweed coating on seed quality and biochemical parameters in barnyard millet. Seaweed is a potential alternative to the chemicals that are used in agriculture.

MATERIALS AND METHODS

Barnyard millet var. MDU 1 seeds were collected from the Department of Seed Science and Technology, Agricultural College and Research Institute, Madurai and the laboratory studies were carried out in the Department of Seed Science and Technology, AC & RI, Madurai. The marine algae *Sargassum myricocystum* (Brown algae), collected from the shores of Mandapam in Ramanathapuram, Tamil Nadu were rinsed with seawater to eliminate visible epiphytes and sand. Subsequently, they were washed with fresh water to eliminate any remaining salt residues. Following this, the seaweed was air-dried in the shade for two weeks. Afterward, they were subjected to oven drying at 40°C for 24 hours and then transformed into powder by using wiley mill.

Barnyard millet seeds were coated with a seaweed formulation of methanol extract. Seaweed methanol extract was prepared using the boiling method by soaking 100g of dried seaweed powder in 100 ml of methanol overnight, then boiling at 100^0C and extract was collected using muslin cloth and centrifuged at 10,000 rpm for 10mins from the clear supernatant was collected and stored in the refrigerator for further use. The formulation is made with polymer, water and seaweed methanol extract according to the polymer procedures. Seeds were coated with different concentrations *viz.*, barnyard millet with five different treatments, *viz.*, T_0- Control, T_1- 10 ml kg^{-1}, T_2- 15 ml kg^{-1}, T_3-20 ml kg^{-1}, T_4- 25 ml kg^{-1} and T_5-30 ml kg^{-1}. Then the seeds are dried to the original moisture content to test the seed quality parameters, such as the germination test, was conducted in quadruplicate by using 100 seeds with four sub replicates of 25 seeds in a paper medium (ISTA, 1999) following an inclined plate method (Punjabi and Basu, 1982) in a germination chamber maintained at a temperature of 25± 1°C and RH 96 ± 2% with diffuse light (approx. 10h.) during the day.

The final count of normal seedlings was recorded on the 8^{th} day, and the percentage of germination was computed. Observations on germination percentage (%), root length (cm), shoot length (cm), dry matter production (g $seedlings^{-1}$), vigour index were calculated (Abdul- baki and Anderson, 1973) and Biochemical parameters such as dehydrogenase activity (Kittock and Law, 1968), electrical conductivity (Presley, 1958), catalase activity (Luck, 1974), peroxidase activity (Malik and Singh, 1980), and leachate sugars (Somogyi, 1952) were observed for both control as well as treated seeds.

The data obtained from different experiments was analyzed with AGRES software (Panse and Sukhatme's 1985). Then the critical difference was calculated at 5 percent (%).

RESULT & DISCUSSION

Among the treatments, barnyard millet seeds coated with *Sargassum spp.* seaweed formulation @ 20 ml kg^{-1} of seeds recorded the highest germination (96%) (Table 1.), while control recorded the lowest germination (80%). The improvement brought about by seaweed extract might also result from the presence of growth hormones, potentially initiating the fresh production of hydrolytic enzymes (Navarro-Lopez *et al*., 2020) and that also cause the release of inhibitors, potentially including abscisic acid, from the seeds by the way it enhances the germination percentage (Vishwakarma *et al*., 2017).

Root length (9.11cm) and shoot length (2.83cm) (Fig. 1) are significantly higher in the treatment @ 20 ml kg^{-1} when compared to the other treatments. Control seeds recorded the lowest root length (4.76cm) and shoot length (1.54cm), respectively. The reason for the increase in root length and shoot length is because seaweed contains natural bio stimulants, trace minerals, vitamins, and plant growth substances are just a few of the helpful substances which promote the growth of the seedlings (Michalak *et al*., 2017).

Table 1: Seed quality parameters and biochemical parameters influenced by seaweed coating formulation.

Treatments	Germination %	Dry Matter Production (g/seedlings)	Vigour Index	Electrical Conductivity (dSm^{-1})	Catalase ($\mu g\ g^1$)	Leachate sugars ($\mu g\ g^1$)
T_0- Control	80 (63.44)	0.019	526	0.35	773	0.24
T_1- 10mlkg^{-1}	86 (68.03)	0.022	714	0.16	805	0.20
T_2- 15mlkg^{-1}	88 (69.73)	0.026	781	0.20	843	0.18
T_3- 20mlKg^{-1}	96 (78.47)	0.033	1146	0.07	922	0.10
T_4- 25mlKg^{-1}	90 (71.57)	0.027	998	0.24	882	0.12
T_5- 30mlKg^{-1}	88 (69.73)	0.025	884	0.26	863	0.16
Mean	88.00	0.025	833	0.213	848	0.166
SEd	1.3682	0.0004	16.781	0.0272	17.7858	0.0043
CD (P=0.05)	2.9811**	0.0009**	36.563**	0.0593**	38.752**	0.0094**

(Values in parentheses indicate arcsine transformed values);
(** - Highly significant at 5% level); (NS – Non significant)

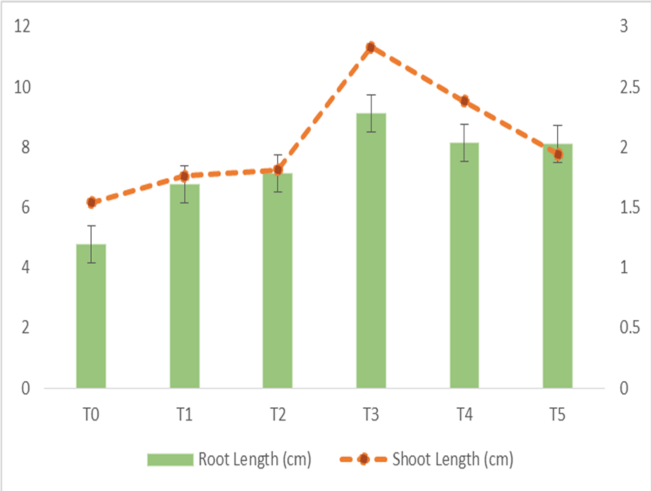

Fig. 1. Effect of seaweed coating formulation on root length and shoot length of barnyard millet.

The plant growth substances such as IAA, Gibberallin, Kinetin, and Zeatin (Zodape *et al.*, 2010) are auxin and cytokinin (Zhang and Ervin 2004) present in the seaweed, which promote cell division and cell elongation thereby it stimulating the germination, root growth, and shoot growth. The bioactive compounds present in the seaweed enhance the root development, nutrient uptake and overall plant growth. The seeds coated @ 20 ml kg^{-1} registered higher dry matter production (0.033g/seedling) and vigour Index (1146) (Fig. 2). Control seeds recorded lower dry matter production (0.019g/seedling) and vigour index (526). The increased vigour index is mainly due to the effective mobilization of the available food reserves in the seaweed coated seeds, resulting in the early emergence and growth of seedlings. In proportion to the increase in seedling growth, the dry matter production also increased. Seaweed contains more essential nutrients such as nitrogen, phosphorous, and other trace elements, which perform more photosynthesis, leading to an increase in dry matter production and vigour index (O Ali *et al.*, 2021). Biochemical parameters such as dehydrogenase (0.402), peroxidase (0.512µg g^{-1}), catalase (922 µg g^{-1}) which are higher in the seeds that are coated with seaweed coated material @ 20 ml kg^{-1} compared to the control and other treatments, and lower the electrical conductivity (0.07dSm^{-1}) and leachate sugars (0.10 µg g^{-1}) (Table 1) Control seeds revealed the lowest dehydrogenase (0.293), peroxidase (0.316), catalase (773 µg g^{-1}) and also observed the highest electrical conductivity (0.35 dSm^{-1}) and leachate sugars (0.24 µg g^{-1}). The ability of seaweed-treated seeds to scavenge reactive oxygen species and maintain cellular redox equilibrium to shield cells from oxidative damage is demonstrated by an increase in catalase and peroxidase activity, which improved seedling vigour and growth (Hasanuzzamann *et al.*, 2020). The dehydrogenase activity in seaweed-treated seeds may be increased, increasing the seed's respiration and energy metabolism, which encourages seed germination and seedling growth.

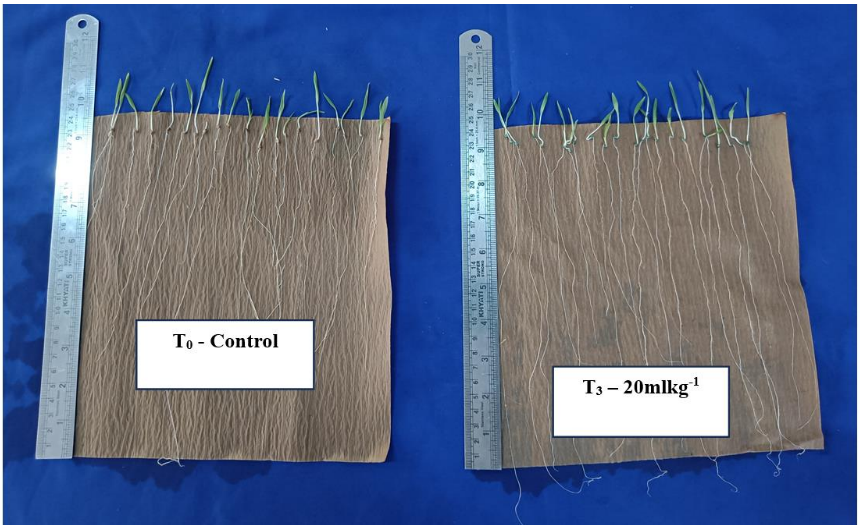

Fig. 2. Effect of seaweed coating formulation on seedling vigour in barnyard millet.

CONCLUSIONS

Among the treatments, seeds coated @ 20mlkg^{-1} recorded better results on physiological and biochemical parameters. It can be concluded that seaweed coated seeds @ 20mlkg^{-1} could be effective and can be used as a pre sowing seed treatment.

FUTURE SCOPE

Seaweed coating in agriculture holds significant promise due to the numerous benefits seaweed extracts can offer to plants and the environment. As sustainable agricultural practices gain importance, seaweed coatings have the potential to revolutionize farming methods.

Acknowledgement. I acknowledge my chairperson and all the members for their suggestion to conduct the experiment during my research work and we sincerely thank the Department of Seed Science and Technology, Agricultural College and Research Institute, Madurai.

Conflict of Interest. None**.**

Ethical Approval. This article does not contain any other studies, human and animal participants which is denoted by any other authors.

REFERENCES

Abdul Baki, A. A., & Anderson, J. D. (1973). Vigour determination in soybean seed by multiple criteria 1. *Crop science*, *13*(6), 630-633.

Afzal, I., Rehman, H. U., Naveed, M., & Basra, S. M. A. (2016). Recent advances in seed enhancements. *New challenges in seed biology-basic and translational research driving seed technology*, 47-74.

Ali, O., Ramsubhag, A., & Jayaraman, J. (2021). Biostimulant properties of seaweed extracts in plants: Implications towards sustainable crop production. *Plants*, *10*(3), 531.

Hasanuzzaman, M., Bhuyan, M. B., Zulfiqar, F., Raza, A., Mohsin, S. M., Mahmud, J. A. & Fotopoulos, V. (2020). Reactive oxygen species and antioxidant defence in plants under abiotic stress: Revisiting the crucial role of a universal defence regulator. *Antioxidants*, *9*(8), 681.

ISTA, (1999). *International Rules for Seed Testing. Seed Sci. & Technol., Supplement Rules, 27,* 25-30.

Kittock, D. L., & Law, A. G. (1968). Relationship of seedling vigour to respiration and tetrazolium chloride reduction by germinating wheat seeds 1. *Agronomy Journal*, *60*(3), 286-288.

Luck, H. (1974). Estimation of catalase activity. *Methods of enzymology. Academic Press, New York* 885.

Malik, R. K., & Singh, C. (1980). The effect of organic acids and cycocel on peroxidase activity of cotton seedlings. *Agrochimica*, *24*(5/6), 478-481.

Michalak, I., Chojnacka, K., & Saeid, A. (2017). Plant growth bio stimulants, dietary feed supplements and cosmetics formulated with supercritical CO_2 algal extracts. *Molecules*, *22*(1), 66.

Navarro-López, E., Ruíz-Nieto, A., Ferreira, A., Acién, F. G., & Gouveia, L. (2020). Biostimulant potential of Scenedesmus obliquus grown in brewery wastewater. *Molecules*, *25*(3), 664.

Panse, V. G., & Sukhatme, P. V. (1954). Statistical methods for agricultural workers. *Statistical methods for agricultural workers.*

Presley, J. T. (1958). Relation of protoplast permeability to cotton seed viability and predisposition to seedling disease. *Plant Disease Reporter*, *42*(7), 852.

Punjabi, B., & Basu, R. N. (1982). Control age-and irradiation-induced seed deterioration in lettuce (*Lactuca sativa L.*) by hydration-dehydration treatments. In *Proc. Indian Natl. Sci. Acad., Part B* (Vol. *48*, No. 2, pp. 242-250).

Rathinapriya, P., Pandian, S., Rakkammal, K., Balasangeetha, M., Alexpandi, R., Satish, L., & Ramesh, M. (2020). The protective effects of polyamines on salinity stress tolerance in foxtail millet (*Setaria italica L.*), an important C4 model crop. *Physiology and Molecular Biology of Plants*, *26*, 1815-1829.

Sarita, S., Chaudhary, S. R., Raj, M., & Kumari, V. Seaweed Extract can Boon the Yield Performances and Profitability of Wheat (*Triticum aestivum*).

Somogyi, M. (1952). Notes on sugar determination. *Journal of biological chemistry*, *195*, 19-23.

Vishwakarma, K., Upadhyay, N., Kumar, N., Yadav, G., Singh, J., Mishra, R. K., & Sharma, S. (2017). Abscisic acid signaling and abiotic stress tolerance in plants: a review on current knowledge and future prospects. *Frontiers in plant science*, *8*, 161.

Zhang, X., & Ervin, E. H. (2004). Cytokinin-containing seaweed and humic acid extracts associated with creeping bentgrass leaf cytokinins and drought resistance. *Crop science*, *44*(5), 1737-1745.

Zodape, S. T., Mukhopadhyay, S., Eswaran, K., Reddy, M. P., & Chikara, J. (2010). Enhanced yield and nutritional quality in green gram (*Phaseolus radiata* L) treated with seaweed (*Kappaphycus alvarezii*) extract.

How to cite this article: A. Madhan Kumar, K. Sujatha, V. Alex Albert, G. Anand and M. L. Mini (2023). Bioefficacy of Seaweed Coating Formulation on Seed Quality and Biochemical Attributes in Barnyard Millet Var. MDU 1. *Biological Forum – An International Journal, 15*(8): 474-477.