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Impact of organic Seaweed pelleting on seed quality and biochemical parameters in brinjal seeds

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Abstract
Brinjal is an important vegetable crop grown in India throughout the year. Precision sowing is difficult with small and irregular shaped seeds. Seed pelleting converts such seeds into bold, spherical with smooth surface that helps in easy handling of seeds during sowing. In addition, organic seaweed pelleting mixtures can be incorporated effectively that will be useful for ensuring better field emergence and crop establishment and productivity. Seeds were pelleted with different mixtures of *Sargassum* sp., *Kappaphycus* sp., Azophos, Biochar and Talc powder. The results reveled that among the treatments seed pelleting with combinations of *Sargassum* sp + *Kappaphycus* sp + Azophos + Biochar + Talc powder was found to be more effective in comparison with other treatments.

Keywords: Azophos, biochar, brinjal, *Kappaphycus sp* sp., *Sargassum* sp., pelleting

Introduction
Brinjal (*Solanum melongena* L.) regularly known as eggplant, comes under the family of Solanaceae. Brinjal is a vegetable crop, extensively cultivated in India and other part of Asian countries like Bangladesh, Pakistan and Philippines. The major brinjal producing countries are China, Turkey, Japan, Egypt, Indonesia, Iraq, Italy, Syria and Spain. India contributes 12,801 thousand metric tons to the global production of brinjal and ranks second after China with an area of 730 thousand hectares. In India, major brinjal producing states are Orissa, Bihar, Karnataka, Tamil Nadu, West Bengal, Andhra Pradesh, Maharashtra and Uttar Pradesh.

Brinjal seed is small in size and it is not suited for mechanical sowing and therefore the size of the seeds has to be increased by seed pelleting. Among seed enhancement techniques seed pelleting is one of the treatment in which the seeds are coated with suitable chemicals/ botanicals /micronutrients and biocontrol agents with the help of adhesive which will increase the required seed size. Pelleting is mostly practiced in small and irregular shaped seeds for easy handling and helps in mechanized sowing (Halmer, 2003 and Rajeswari *et al.*, 2020) [5, 15]. Seed pelleting is the process of enclosing a seed with small quantities of inert material just large enough to produce globular unit of standard size to facilitate precision planting. The inert material creates natural water holding media and provides a small amount of nutrients to young seedlings (Krishnasamy, 2003) [10]. Pelleting of seed with adhesive, fillers and bioactive chemicals focuses on the performance of the seeds. This helps in the achievement of desired population, which is the key basis for successful crop/seed production. Seed pelleting with botanicals are the cheapest and non-toxic and provide protection from pests and diseases during germination and early crop growth (Kavitha *et al.*, 2009) [8]. Seeds pelleted with nutrients improve the initial growth and emergence of the seedling. Organic pellets are characterized by a greater ability to absorb water than mineral or organic-mineral pellets. Hence, present investigation was conducted to find out the suitable low cost organic pelleting materials and to standardize and optimize the technique of seaweed pelleting mixtures and to its effect on seed quality in brinjal seeds.

Materials and Methods
Genetically pure seeds of Brinjal (*Solanum melongena* L.) cv. CO 2 obtained from the Department of Vegetable crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Periyakulam used as base material and the experiment was carried out at the Department of Seed Science and Technology, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai during 2021.

During pelleting the seeds were spread in a thin layer and sprayed with adhesive (4%) over the seeds. Wet seeds were transformed to a container and measured quality of pelleting mixture were added. Seeds were pelleted with the seaweeds *Sargassum* and *Kappaphycus sp* and with, Azophos (biofertilizer), biochar, talc powder with the following treatments *viz*., T1- Control (unpelleted seeds), T2 – Biochar, T3 -Talc powder, T4 – Azophos, T5- Sargassum sp + Kappaphycus sp + Biochar, T6 - Sargassum sp + Kappaphycus sp +Talc powder, T7- Sargassum sp + Kappaphycus sp + Azophos, T8- Sargassum sp + Kappaphycus sp sp + Biochar + Azophos, T9 - Sargassum sp + Kappaphycus sp + Azophos + Talc powder, T10- Sargassum sp + Kappaphycus sp + Azophos + Talc powder + Biochar. The experiment was undertaken with three replications in a completely randomized block design and evaluated for germination (ISTA 2015) [6], shoot length (cm), root length (cm), dry matter production per 10 seedlings (g), vigour index values (Abdul-Baki and Anderson 1973) [1]. The other parameters were evaluated after removing the pelleted material. The electrical conductivity was measured in duplicate with little modification of Presley (1958) [13] by soaking 25 seeds in 50ml water for a duration of 20h and expressed as dSm^{-1}. After measuring the EC, the seed leachate was used for the assesing Leachate sugars ($\mu g\ g^{-1}$) according to Somogyi, (1952) [17] with minor modifications and Leachate free amino acids ($\mu g\ g^{-1}$) estimated in duplicate following the method described by Moore and Stein, (1948) [12] with minor modifications. Dehydrogenase activity (Kittock and law 1968) [9], catalase activity (Luck 1974) [11], and antioxidant activity (Blois 1958) [2] were also assessed.

Statistical Analysis

The data observed were analysed statistically using AGRES software, by the methods described by Panse and Sukhatme (1985) [14]. Whenever necessary value in the percent data was transformed to arcsine transformation and 5% level critical difference was computed.

Results and Discussion

Among the treatments seeds pelleted with sarga + kappa + Azophos + Biochar + Talc powder recorded higer germination (88%) root length (4.7 cm), shoot length (4.4 cm), dry matter production (0.018 g/10 seedlings), vigour index I (800), compared to other treatments. Unpelleted seeds recorded the lowest germination percentage (76%), root length (3.8 cm), shoot length (3.4 cm), dry matter production (0.015 g/10 seedlings), vigour index I (547) respectively (Table 1). Coating with seaweeds enhanced the physiological quality parameters. Seaweeds are rich in growth promoting substances (Sylvia *et al.*, 2005) [21] such as IAA, kinetin, zeatin and gibberellins (Zodape *et al.*, 2010) [24] auxins and cytokinins (Zhang and Ervin, 2004) [22]; metabolic enhancers; macro and micro elements (Strik *et al.*, 2003) [18] may be enhanced the seed quality parameters. Biochar, which is derived from biomass, has proven to have beneficial effects on seed germination and radicle extension (Chen, 2021) [4] and also it stimulated seed germination and increased seedling mass (Bogdan Saletnik *et al*., 2019) [16]. Biofertilizers improve the root development, vegetative growth and nitrogen fixation. They liberate growth promoting substances and vitamins and help to maintain soil fertility, improve physical properties of soil, soil health in general and help in the bio-control of disease (Iswariya *et al*., 2019) [7]. Suma *et al*., 2014 found out that seed pelleting with Azophos have shown higher seedling characters compared to control in *Sesamum indicum*. Seeds pelleted with sarga + kappa + Azophos + Biochar + Talc powder recorded lowest EC (0.255 dSm^{-1}), Leachate sugars (23.14 $\mu g\ g^{-1}$) and Leachate free amino acids (32.3 $\mu g\ g^{-1}$) compared to other treatments. The highest antioxidant activity of 65.10%, dehydrogenase (0.612), peroxidise (0.393) and catalase activities (0.672 µmol of H_2O_2 $min^{-1}\ gram^{-1}$) observed in T_{10} treatment (Table 2).

The unpelleted seeds recorded higher EC (0.312 dSm^{-1}), Leachate sugars (27.36 $\mu g\ g^{-1}$) and Leachate free amino acids (39.2 $\mu g\ g^{-1}$). The electrical conductivity of seed leachate was low in pelleted seed. The results were in conformity with the findings of Sujatha in blackgram redgram and cowpea and Vethanayagi *et al.* (2011) [19] in bhendi. Unpelleted seeds also have recorded the lowest antioxidant activity of 50.24%, dehydrogenase (0.337), peroxidise (0.101) and catalase activities (0.257 µmol of H_2O_2 $min^{-1}\ gram^{-1}$).

Antioxidant is the collective name for the vitamins, minerals, carotenoids and polyphenols that prevent the harmful effect of free radicals. Antioxidants terminate these chain reactions by removing free radical intermediates and inhibit other oxidation reactions by being oxidized themselves and increased the performance of seeds (Butkhup and Samappito, 2011) [3].

Analysis of DPPH free radical scavenging activity of seaweeds treated seeds revealed that higher antioxidant property. Peroxidase plays a viable role in seed quality determination as it acts as a protectant against accumulation of peroxides and causes the decomposition of hydrogen peroxide into water and oxygen (Zhang and Khfirkhan, 1994) [23]. Pelleted seed recorded higher antioxidant activity, dehydrogenase and peroxidase and lower value of free amino acids, sugar and electrical conductivity. Seed pelleted with *Sargassum* sp + *Kappaphycus* sp + Azophos + Biochar + Talc powder recorded higer seed quality as well as biochemical parameters *viz*., dehydrogenase, peroxidise, catalase, antioxidant activity and lowers values of electrical conductivity, leachate free amino acids and leachate free sugars.

Table 1: Seaweed pelleting and its effect on seed quality parameters

Treatments	Germination (%)	Root length(cm)	Shoot length (cm)	Dry matter production (g/10 seedlings)	Vigour index
T_1 Control	76 (60.66)	3.8	3.4	0.0150	547
T_2 Biochar	82 (64.89)	3.9	4.0	0.0160	663
T_3 Talc powder	80 (63.43)	3.8	3.8	0.0150	608
T_4 Azophos	82 (64.89)	3.9	3.9	0.0155	639
T_5 Sarga + Kappa + Biochar	86 (68.02)	4.2	4.3	0.0170	731
T_6 Sarga + kappa +Talc powder	85 (67.21)	4.1	4.2	0.0170	713
T_7 Sarga + kappa + Azophos	84 (66.42)	4.0	4.1	0.0165	680
T_8 Sarga + kappa + Biochar + Azophos	86 (68.02)	4.2	4.3	0.0175	748

T_9 Sarga + kappa + Azophos + Talc powder	83 (65.65)	4.0	4.0	0.0165	672
T_{10} Sarga + kappa + Azophos + Biochar + Talc powder	88 (69.73)	4.7	4.4	0.0180	800
Mean	83.2	4.06	4.04	0.0164	680
SEd	0.02	0.0192	0.0658	0.0004	11.0740
CD (P=0.05)	0.05	0.0400	0.1372	0.0008	23.1000

Table 2: Seaweed pelleting and its effect on biochemical parameters

Treatments	Electrical conductivity (dSm^{-1})	Antioxidant activity (%)	Dehydrogenase (OD value)
T_1 Control	0.312	50.24 (45.13)	0.337
T_2 Biochar	0.300	56.17 (48.54)	0.401
T_3 Talc powder	0.302	54.08 (47.34)	0.385
T_4 Azophos	0.302	54.32 (47.47)	0.396
T_5 Sarga + Kappa + Biochar	0.274	60.23 (50.90)	0.513
T_6 Sarga + kappa +Talc powder	0.280	60.00 (5076)	0.486
T_7 Sarga + kappa + Azophos	0.286	58.42 (49.84)	0.470
T_8 Sarga + kappa + Biochar + Azophos	0.267	63.75 (52.98)	0.572
T_9 Sarga + kappa + Azophos + Talc powder	0.292	57.54 (49.33)	0.458
T_{10} Sarga + kappa + Azophos + Biochar + Talc powder	0.255	65.10 (53.79)	0.612
Mean	0.287	57.985	0.463
SEd	0.0019	0.5753	0.0096
CD (P=0.05)	0.0040	1.2000	0.0200

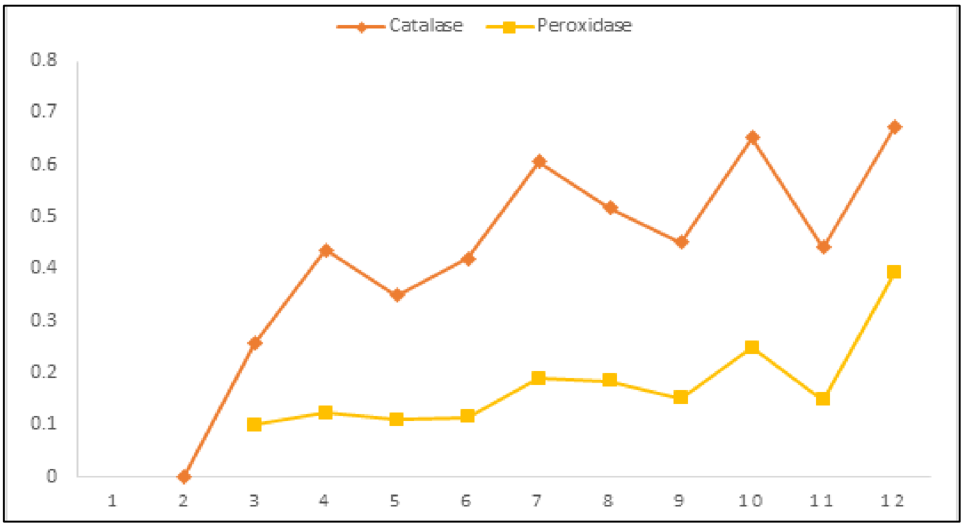

Fig 1: Effect of seaweed pelleting on Catalase & Peroxidse activity in Brinjal seed (CO 2) T_1 - Control T_2 - Biochar T_3 - Talc powder T_4 – Azophos T_5 -Sarga + Kappa + Biochar T_6 - Sarga + kappa +Talc powder T_7 - Sarga + kappa + Azophos T_8 - Sarga + kappa + Biochar + Azophos T_9 - Sarga + kappa + Azophos + Talc powder T_{10} - Sarga + kappa + Azophos + Biochar + Talc powder

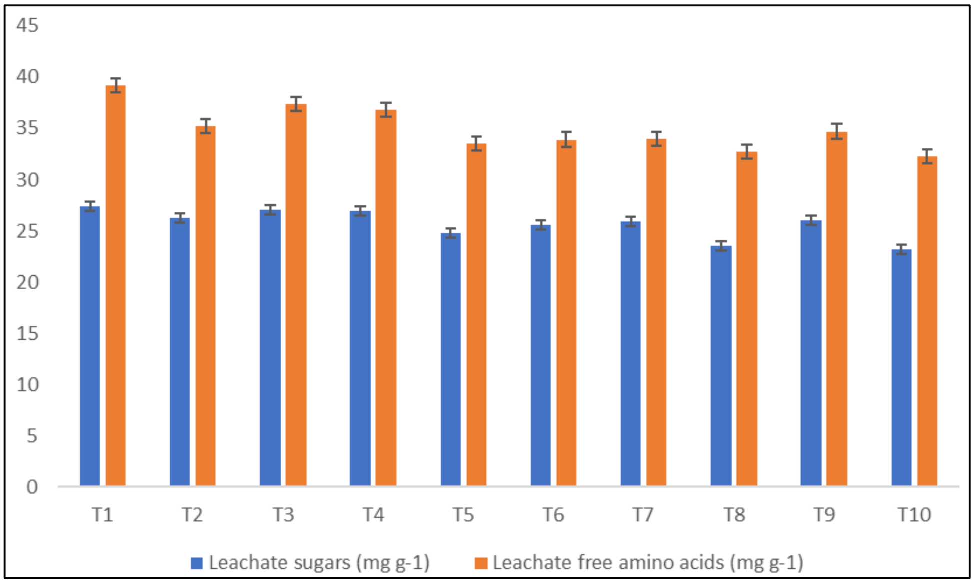

Fig 2: Effect of seaweed pelleting on Leachate free sugars & Leachate free amino acids of Brinjal (CO 2) T_1 - Control T_2 - Biochar T_3 - Talc powder T_4 – Azophos T_5 -Sarga + Kappa + Biochar T_6 - Sarga + kappa +Talc powder T_7 - Sarga + kappa + Azophos T_8 - Sarga + kappa + Biochar + Azophos T_9 - Sarga + kappa + Azophos + Talc powder T_{10} - Sarga + kappa + Azophos + Biochar + Talc powder

Conclusion
It could be concluded that seaweed pelleting with Sargassum sp, Kappaphycus sp, Azophous, biochar and Talc powder was found to be superior in all aspects of seed quality and biochemical parameters. And it is recommended for mechanical sowing.

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