Original Research Article

Influence of organic Seaweed pelleting on seed quality parameters of onion seeds

---

ABSTRACT

Aim: Small and irregular seed shapes make precision sowing difficult. Seed pelleting, which helps to make seed handling easier during sowing, is converting such seeds into bold, spherical shapes with a smooth surface.Seaweeds are a rich source of nutrients (Sylvia et al., 2005) that promote growth, such as IAA, kinetin, zeatin, and gibberellins (Zodape et al., 2010); auxins and cytokinins (Zhang and Ervin, 2004); metabolic enhancers; macro and micro elements (Strik et al., 2003); amino acids; and vitamins. Their use in crop plants has been shown to have positive effects, including early seed germination and establishment, improved crop performance and yield, increased resistance to biotic and abiotic stress, and increased seed shelf life (Bluden, 1994).

Study design: The experiment was undertaken with three replications in a completely randomized block design. Eight treatmental combinations were used in this study.Statistical analysis was carried out by AGRES software.The Critical Differences (CD) was calculated at 5 per cent probability level.

Place and Duration of Study: Department of Seed Science and Technology, Agriculture College and Research Institute, TNAU, Madurai, during the period of December 2020 and November 2021.

Methodology: Organic seaweed pellet combinations can be successfully implemented to provide improved field emergence, crop establishment and production. Seeds were pelleted with different mixtures of *Sargassum* sp., *Kappaphycus*sp., *Bacillus subtilis*and Talc powder.

Result: The results exposed that between the treatments seed pelleting with combination of **T_7**- *Sargassum sp* + *Kappaphycus*sp + *Bacillus subtilis*+ Talc powder was found to be more efficient in comparison with other combinations.

Conclusion: Pelleting with *Sargassum*sp, *Kappaphycus*sp, *Bacillus subtilis*and Talc powder was found to be better in all aspects of seed quality and biochemical parameters.

Keywords: Bacillus subtilis, Onion, *Kappaphycus sp., Sargassum sp.,* Pelleting.

1. INTRODUCTION

"Onion (*Allium cepa* L.,) comes below the family of Amaryllidaceae. Onion is aimportant vegetable crop, extensively cultivated in India and other part of Asian countries like Bangladesh, Pakistan and Philippines. The major onion producing countries are China, Turkey, Japan, Egypt, Indonesia, Iraq, Italy, Syria and Spain". [30] "India contributes 24 million tons to the global production of onion and ranks second after China with an area of7.80 Lakh hectares" (NHB, 2020). In India, major onionproducing states are Maharashtra, Madhya Pradesh, Karnataka, Rajasthan, Bihar, Gujarat, Andhra Pradesh, Haryana, West Bengal and Uttar Pradesh.

Onion seeds are small and inappropriate for mechanical sowing, seed pelleting must be used to enlarge the seeds' size. One method of treating seeds that increases the needed seed size is called seed pelleting. It involves coating the seeds with appropriate chemicals, botanicals, micronutrients, and biocontrol agents using an adhesive. For ease of handling and to aid in mechanical sowing, pelleting is mostly used on small, irregularly shaped seeds (Halmer, 2003 and Rajeswariet al., 2020).

"In order to facilitate precise planting, a method known as "seed pelleting" involves encasing a seed in small amounts of inert material that are just big enough to produce globular units of a specified size" (Talha *et al.,* 2022). The inert substance gives young seedlings a small quantity of nutrients and produces natural water-holding medium (Krishnasamy, 2003). The performance of the seeds is the main emphasis of pelleting them with adhesive, fillers and bioactive compounds. This helps in reaching the desired population, which is essential for producing crops and seeds successfully. During germination and early crop growth, seed pelleting with botanicals (or) organics is the least expensive, non-toxic method that protects against pests and diseases (Tengfei *et al*., 2022 and Kavitha*et al.,* 2009).Nutrient-pelletized seeds provide better seedling emergence and early development (Roos 1979). The ability of organic pellets to absorb water is higher than that of mineral or organic-mineral pellets. Hence, the main objective of the current study was to determine which low-cost organic pelleting materials would be best for standardizing and improving seaweed pelleting combination procedures and their impact on onion seed quality.

2. MATERIALS AND METHODS

Genetically pure seeds of Onion (*Allium cepa* L.,)CO (On) 5 obtained from the Department of Vegetable crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Periyakulamwas used as base material and the experiment was carried out in the Department of Seed Science and Technology, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai during 2021. The seeds were sprayed with adhesive (4%) after being spread out thin layer for pelleting. After transferring the wet seeds into a container, a predetermined quantity of pelleting mixture was added. Seeds were pelleted with along the following treatments viz., T_0- Control (unpelleted seeds), T_1- Talc powderT_2 - *Bacillus subtilis*, T_3 - *Bacillus subtilis* + Talc powder, T_4 - *Sargassum*sp + Talc powder, T_5 –*Kappaphycus*sp + Talc powder, T_6 –*Sargassum*sp + *Kappaphycus* sp + Talc powder, T_7- *Sargassum sp* + *Kappaphycus*sp + *Bacillus subtilis* + Talc powder. The experiment was undertaken with three replications in a completely randomized block design and evaluated for germination (ISTA 2013), shoot length (cm), root length (cm), dry matter production 10 per seedlings (g), vigour index values (Abdul-Baki and Anderson 1973). After the pelleted material was removed, the remaining parameters were assessed.The electrical conductivity was calculated in duplicate with slight modification of Presley (1958) by soaking 25 seeds in 50ml water for duration of 20hand expressed as dSm^{-1}. Following the EC measurement, the seed leachate was used to measure leachate sugars (µg g-1) with some modifications based on Somogyi (1952) and leachate free amino acids (µg g-1) in duplicate using a method outlined by

Moore and Stein (1948) with minor modifications. Also measured the activities of dehydrogenase (Kittock and Law 1968), catalase (Luck 1974), and antioxidants (Blois 1958).

3. RESULTS AND DISCUSSION

Between the treatments seeds pelleted with *Sargassum sp* + *Kappaphycus*sp + *Bacillus subtilis* + Talc powder recorded higher germination (86%) Seedling length (17.43 cm), dry matter production (0.036g/10 seedlings) andvigour index I (1499), compared to other treatments. Unpelleted seeds recorded the lowest germination percentage (76%), Seedling length (14.86cm), dry matter production (0.022g/10 seedlings) andvigour index I (1129)(Table 1). Seaweed coating improved the parameters of physiological quality. Growth enhancing compounds such IAA, kinetin, zeatin, and gibberellins (Zodapeet al., 2010), auxins and cytokinins (Zhang and Ervin, 2004), metabolic enhancers, and macro and micro elements (Striket al., 2003) are abundant in seaweeds (Sylvia et al., 2005). These substances may also improve the parameters related to seed quality. Nitrogen fixation, vegetative growth, and root development are all enhanced by biofertilizers. They release compounds that promote growth and vitamins, help in preserving soil fertility, enhance the physical characteristics of the soil, enhance soil health in general, and support the biocontrol of disease (Iswariya et al., 2019). According to Sumaet *et al*. (2014), seed pelleting with Bacillus subtilis in Sesamum indicum resulted in higher seedling characteristics than the control. Seeds pelleted with *Sargassum sp* + *Kappaphycus*sp+ *Bacillus subtilis*+ Talc powderrecorded lowest EC (0.273dSm^{-1}), leachate sugars (23.80$\mu g\ g^{-1}$) and leachate free amino acids (37.90$\mu g\ g^{-1}$) compared to other treatments (Table 2, Fig 1,2). The highest dehydrogenase (0.072), peroxidise (1.37) and catalase activities (1.49 µmol of H_2O_2 min^{-1} $gram^{-1}$) observed in T_7 treatment. The unpelleted seeds recorded higher EC (0.294dSm^{-1}), leachate sugars (28.65$\mu g\ g^{-1}$) and leachate free amino acids (42.25$\mu g\ g^{-1}$).The electrical conductivity of seed leachate was low in pelleted seed. The results were in conformity with the findings ofSujatha (2006) in blackgram, redgram and cowpea and Vethanayagi*et al.,* (2009) in bhendi. Unpelleted seeds also have recorded the lowest dehydrogenase (0.060), peroxidise (1.24) and catalase activities (1.42 µmol of H_2O_2 min^{-1} $gram^{-1}$).

The term "antioxidant" refers to the group of vitamins, minerals, polyphenols, and carotenoids that work together to stop free radical damage. By eliminating free radical intermediates, antioxidants stop these chain events. They also prevent further oxidation processes by being oxidized themselves, which improves seed performance (Butkhup and Samappito, 2011). The enhanced antioxidant capability of seaweed-treated seeds was shown by analysis of their DPPH free radical scavenging activity. Because it breaks down hydrogen peroxide into water and oxygen and protects against the accumulation of peroxides, peroxidase is a useful tool in the assessment of seed quality (Zhang and Khfirkhan, 1994).Pelleted seed had reduced levels of sugar, electrical conductivity, and free amino acids and increased levels of dehydrogenase and peroxidase.Seed pelleted with *Sargassum* sp+ *Kappaphycus*sp + *Bacillus subtilis*+ Talc powderrecorded higher seed quality as well as biochemical parameters viz., dehydrogenase, peroxidise, catalase, and lowers values of EC, leachate free amino acids and leachate free sugars.

Table 1. Effect of pelleting treatments on physiological quality of onion

Treatment Details	**Germination (%)**	**Seedling length (cm)**	**DMP (mg/10seedlings)**	**Vigour index I**
T_0	76(66.67)	14.86	0.022	1129
T_1	76(66.67)	14.97	0.023	1138
T_2	80(63.44)	15.67	0.026	1254
T_3	78(62.03)	15.15	0.025	1182
T_4	83(65.65)	16.30	0.030	1353
T_5	81(64.16)	15.88	0.029	1286
T_6	84(66.42)	16.87	0.033	1417

T_7	86(68.03)	17.43	0.036	1499
Mean	**81(64.16)**	**15.89**	**0.028**	**1282**
SEd	1.625	0.376	0.0008	25.004
CD (0.05)	3.444**	0.796**	0.0016**	53.007**

(Figures in parentheses indicate arc sine value)

NS - Non Significant ** - Highly Significant

SEd- Standard error of the difference between means, **CD** -Critical Differences

T_0 – Control T_1 - Talc powder T_2 – *Bacillus subtilis* T_3 - *Bacillus subtilis* + Talc powder

T_4 - *Sargassum*sp + Talc powder T_5 - *Kappaphycus*sp + Talc powder

T_6 - *Sargassum*sp + *Kappaphycus* sp + Talc powder

T_7- *Sargassum* sp + *Kappaphycus*sp + *Bacillus subtilis* + Talc powder

Table 2. Effect of different pelleting treatments on biochemical parameters of onion

Treatment Details	Dehydrogenase (OD value)	Peroxidase (units/gram)	Catalase (units/gram)	Electrical conductivity (ds/m)	Leachate free amino acids (µg/g)	Leachate free sugars (µg/g)
T_0	0.060	1.24	1.42	0.294	42.25	28.65
T_1	0.060	1.25	1.42	0.290	42.10	28.10
T_2	0.063	1.29	1.44	0.283	40.65	26.80
T_3	0.061	1.27	1.43	0.287	41.22	27.50
T_4	0.067	1.33	1.46	0.278	39.18	25.24
T_5	0.066	1.32	1.45	0.281	39.85	26.11

T_6	0.069	1.35	1.47	0.275	38.74	24.43
T_7	0.072	1.37	1.49	0.273	37.90	23.80
Mean	**0.065**	**1.30**	**1.45**	**0.283**	**40.24**	**36.33**
SEd	0.001	0.028	0.033	0.004	0.746	0.418
CD (0.05)	0.002**	0.060**	0.071*	0.009**	1.582**	0.887**

NS - Non Significant   ** - Highly Significant

SEd Standard error of the difference between means, **CD**Critical Differences

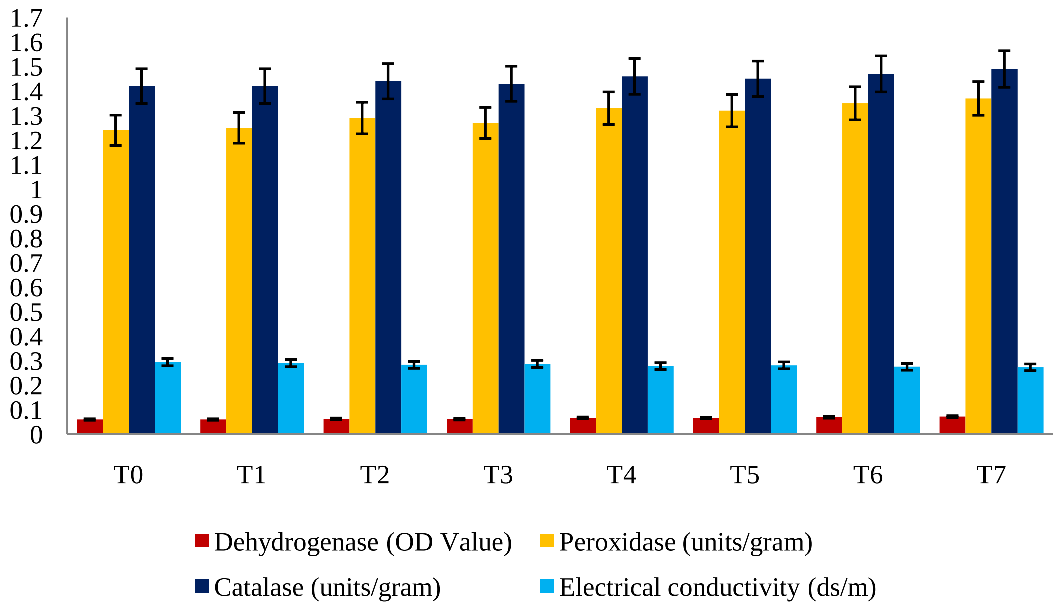
T_0 – Control T_1 - Talc powder T_2 – *Bacillus subtilis* T_3 - *Bacillus subtilis* + Talc powder

T_4 - *Sargassum*sp + Talc powder T_5 - *Kappaphycus*sp + Talc powder

T_6 - *Sargassum*sp + *Kappaphycus* sp + Talc powder

T_7- *Sargassum* sp + *Kappaphycus*sp + *Bacillus subtilis* + Talc powder

Fig. 01 Effect of different pelleting treatments on biochemical parameters of onion



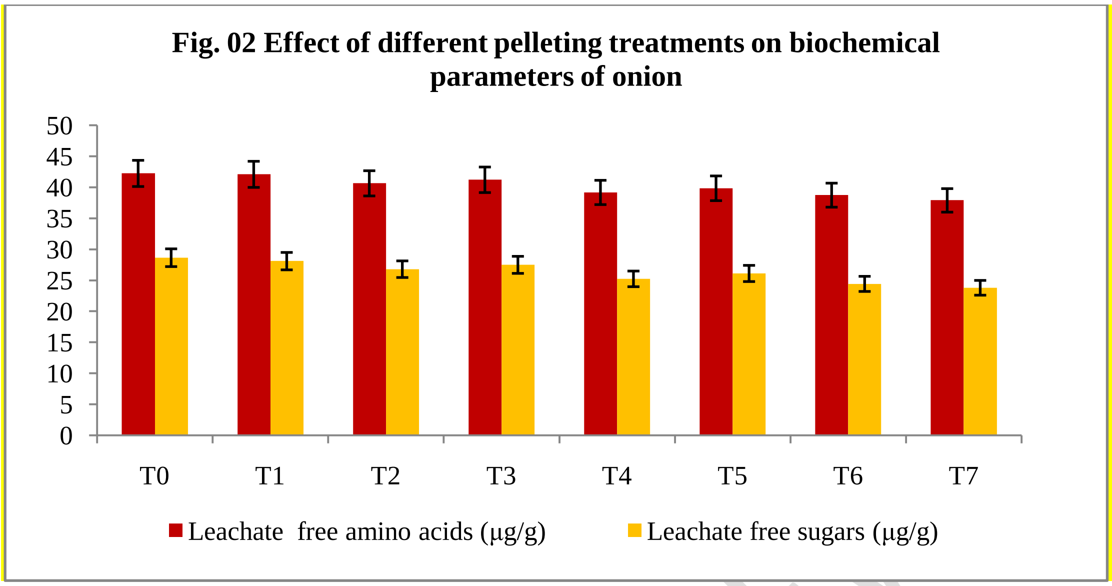


Fig. 02 Effect of different pelleting treatments on biochemical parameters of onion

4. CONCLUSION

This study revealed that seeds pelleted with different seaweed pelleting mixture *Sargassum* sp + *Kappaphycus* sp + *Bacillus subsitilis* + Talc powder (T_7) were found suitable to get fine, round and smooth seed pellets in onion. The germination was not affected by pelleting. Pelleting mixtureincreased the seed germination, seedling growth, dry matter production and vigour index. And also increased the biochemical parameters of seed. T_7 in onion was found to be the best combinations for improving the seedlingvigour.Further research and development are essential to optimize these combinations for maximum efficiency and sustainability.

REFERENCES

1. Abdul-Baki, A. A. and J. D. Anderson. Vigour determination in soybean seed by multiple criteria. Crop Sci., 1973;13: 630-633.
2. Ambika, S., &Sujatha, K. Organic seaweed nano powder effect on growth and yield attributes of pigeonpea. Legume Research,2016; 40(4), 731-734.

3. Balaji, D. S., and G. SathityaNarayana. "Effect of various bio priming seed enhancement treatment on seed quality in certain minor millets." *Plant Archives* 19.1 (2019): 1727-1732.
4. Bharathi, A., P. Nateshan, K. Vanangamudi, P. S. Sherin, M. Ramya and P. Thangavelu. Conceptual and utility differences among seed enhancement technologies viz., seed pelleting, seed coating and seed coloring. ICAR short course on seed hardening and pelleting technologies for rainfed/garden land ecosystems. Tamil Nadu Agricultural University, Coimbatore,2003; p. 131.
5. Blunden, G. Agricultural uses of seaweeds and seaweed extracts. In: Seaweed resources in Europe: Uses and potential. M. D.Guiry and G. Bluden (eds). Wiley, Chicester.1994; pp: 65- 81
6. Butkhup, L. and S. Samappito. In vitro free radical scavenging and antimicrobial activity of some selected thai medicinal plants. Res. J. Med. Plant., 2011;5:254 – 265.
7. Chen, Zijun. "Effects of biochar-based seed coating binders on seed germination and radicle extension."(2021)
8. Halmer, P. Enhancing seed performance for better yield and quality. Asian Seeds Plant Mater. 2003;10: 4-7.
9. ISTA. "International Rules for Seed Testing, Rules." International Seed Testing Association. Zurich,ISTA Secretariat.2013
10. Iswariya, S., K. Sujatha and Subhashini, R. Enhancement of Seedling Vigour through Bio-priming for Barnyard Millet Var. MDU 1. Int.J.Curr.Microbiol.App.Sci. 2019;8(04): 2254-2259.
11. Kavitha, M.; Deshpande, V.K.; Vyakaranahal, B.S.; Awakkanavar, J.S.; Yashoda, H. and Mathad, J.C. Seed pelleting with organic and inorganic inputs for vigour and viability in chilli seeds. Karnataka J. Agric. Sci. 2009;22(2): 15-19

12. Kittock, D. L. and A. G. Law. Relationship of seedling vigour, respiration and tetrazolium chloride reduction by germination of wheat seeds. Agron. J.,1968; 60: 286-288.

13. Krishnasamy, V. "Seed pelleting principles and practices." *ICAR short course on seed hardening pelleting technologies for rainfed/garden land ecosystems,* May 27,2003

14. Luck, H. Assay of catalase. In: Methods in Enzymatic Analysis 2 (Ed Bermeyer), Academic Press, New York: 1974;Pp. 885.

15. Moore, S. and W. H. Stein. Photochromic ninhydrin method for use in chromatography of amino acids. J. Biol. Chem.,1948; 176: 367-388.

16. Presley, J.T. "Relationship of protoplast permeability of cotton seed viability and predisposition of seedling disease. ." Pl. Dis. Reptr., 1958;42 (7):582.

17. Rathore, S.S., D. R. Chaudhary, G.N. Boricha, A. Ghosh, B.P. Bhatt, S.T. Zodape and J.S. Patolia. Effect of seaweed extract on the growth, yield and quality of soybean (*Glycine max*) under rain fed conditions. South African Journal of Botany, 2009;75: 351-355.

18. Roos, E.E. "Storage behavior of pelleted, tableted and taped lettuce seed." *ROOS*.1979.

19. Saletnik, B., Bajcar, M., Zaguła, G., Saletnik, A., Tarapatskyy, M., &Puchalski, C. biochar as a stimulator for germination capacity in seeds of Virginia mallow (Sidahermaphrodita (L.) Rusby). *Applied Sciences*, 2019; *9*(16), 3213.

20. Shashibhaskar MS. Influence of seed pelleting on field performance and storability of tomato (Lycopersiconesculentum Mill.) cv. PKM-1. M.Sc. (Ag.) Thesis, University of Agricultural Sciences, Dharwad; 2008.

21. Somogyi, M. Notes on Sugar Determintion. J. Biol. Chem., 1952; 200: 245-247.

22. Strik, W. A., M. S. Novak and J. Van Staden. Cytokinins in macroalgae. Plant Growth Regul., 2003; 41: 13 - 24.

23. Sujatha, K., G. Vethanayagi and K. Ramamoorthy. Studies on the effect of seaweed extracts on storage potential in bhendi seeds. Seaweed Res. Utiln., 2011; 33(1&2): 125-131.

24. Suma, N. Studies of seed quality enhancement techniques in sesamum (Sesamumindicum L.) cv. Co-1 in sesamum. M.Sc. Thesis, Tamil Nadu Agricultural University, Coimbatore, 2005.

25. Sylvia, S., M. Baluswami, M. D. VijayaParthaSarathy and V. Krishnamurthy. Effectof liquid seaweed fertilizers extracted from *Gracilariaedulis*, Silva, *Sargassumwightii*and*Ulvalactuca*on the growth and yield of *Abelmoschusesculentus*. Indian Hydrobiology, 2005; 7: 69- 88.

26. Talha Javed, Irfan Afzal, Rubab Shabbir, Kamran Ikram, Muhammad Saqlain Zaheer, Muhammad Faheem, Hafiz Haider Ali, Javaid Iqbal, Seed coating technology: An innovative and sustainable approach for improving seed quality and crop performance. Journal of the Saudi Society of Agricultural Sciences,2022; 21(8): 536-545

27. Tengfei, X., Nanda, S., Fengliang, J., Qingsheng, L., & Xia, F. (2022). Control efficiency and mechanism of spinetoram seed-pelleting against the striped flea beetle Phyllotreta striolata. Scientific Reports, 2022; *12*(1): 9524.

28. Zhang, X. and E. H. Ervin. Cytokinin-containing seaweed and humic acid extracts associated with creeping bentgrass leaf cytokinins and drought resistance. Crop Sci., 2004; 44: 1737- 1745.

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

30. Elamparithi R, Sujatha K, Menaka C, Senthil K. Impact of organic Seaweed pelleting on seed quality and biochemical parameters in brinjal seeds. Pharma Innov. 2021;10:1466-9.