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Effect of Freshwater Crab Shell Powder *Oziotelphusa Aurantia* (H.) as an Organic Fertilizer to Increase Dramatic Growth in the Plant *Abelmoschus Esculentus* (L.)

P. Kalaimagal[1], S. Muthalagi[2*], G. Senthil Kumar[3]
[1]*Assistant Professor and Head, Department of Zoology, Joseph Arts and Science College, Thirunavallur, India*
[2]*Assistant Professor, PG and Research Department of Zoology, Thiru Kolanjiappar Government Arts College, Vriddhachalam, India*
[3]*Associate Professor and Head, PG and Research Department of Zoology, Thiru Kolanjiappar Government Arts College, Vriddhachalam, India*

***Abstract*: The pursuit of sustainable agriculture has intensified the search for effective organic fertilizers from renewable resources. Crustacean shell waste, rich in chitin, minerals and nutrients, represents a promising yet underutilized resource for enhancing soil fertility and plant growth. This study investigated the efficacy of freshwater crab (*Oziotelphusa aurantia*) shell powder (CSP) as an organic fertilizer on the growth and yield of okra (*Abelmoschus esculentus*), in comparison to vermicompost and an unamended control. A pot experiment was conducted using red soil amended with CSP at 0.5% (w/w), vermicompost and a control. Growth parameters, including germination rate, plant height, leaf number and dimensions, flowering time and pod yield were monitored over eight weeks. CSP amendment significantly enhanced plant growth and productivity. Germination commenced one day earlier in the CSP-treated soil compared to the control and vermicompost. Plants grown in CSP-amended soil demonstrated superior performance in vegetative growth, producing a greater number of leaves, larger leaf dimensions (9 cm length, 10 cm width by week 6) and a higher final plant height. While flowering initiated slightly later than in the vermicompost group, CSP-treated plants yielded a significantly greater number of pods (12 per plant), with longer pod length (12.2 cm) heavier pod weight (11 g) and a higher total yield per plant (200 g) compared to both vermicompost (120 g) and the control (82.5 g). Freshwater crab shell powder is a highly effective organic fertilizer that significantly improves the growth, yield and nutritional quality of *Abelmoschus esculentus*. The utilization of this aquaculture waste product offers a sustainable strategy for enhancing agricultural productivity, improving soil health and reducing environmental pollution.**

***Keywords*: Organic Amendment, Chitin, Okra, Sustainable Agriculture, Waste Valorisation, Soil Health.**

1. Introduction

The extensive use of inorganic fertilizers in modern agriculture, while boosting yields, has led to the accumulation of toxic residues in soil, adversely affecting plant health and environmental quality (Hong and Mun, 1995). A safer and more sustainable alternative lies in the adoption of organic farming practices which utilize natural products to nourish plants and improve soil structure (Cho and No, 1999). Organic farming enhances soil biodiversity and promotes long-term food security (Sahota *et al*., 2013), requiring that all essential nutrients are present in the soil in accessible forms and balanced proportions (Roy *et al*., 2006).

In this context, crustacean shell waste a significant byproduct of the seafood industry, presents a valuable resource. These wastes are rich in chitin, a polysaccharide known for its eliciting properties that activate defense responses in plants, improving their resistance to pathogens and pests (Hamed *et al*., 2016). Historical texts like Vyrukshayurveda even allude to the use of crab-derived materials in plant care (Nalini, 1996, 2004). Previous research has demonstrated the positive effects of crustacean amendments; for instance, crab shell application improved nodulation and yield in soybeans (Ali *et al*., 1997) and chitin from freshwater crabs was reported to dramatically enhance the growth of Cucurbitaceae plants (Sarva and Giri, 2015).

Despite this potential the disposal of such waste remains an environmental challenge. Therefore, this study aims to valorize freshwater crab (*Oziotelphusa aurantia*) shell waste by evaluating its efficacy as an organic fertilizer on the growth and yield of okra (*Abelmoschus esculentus*) comparing its performance against vermicompost and an unfertilized control.

2. Materials and Methods

Present study was made to prepare a biofertilizer from the fresh water crab shell powder (CSP) of *Oziotelphusa aurantia* and to investigate its drastically efficacy in plant growth in *Abelmoschus esculuntus*. Collection of samples: The freshwater crab shells were collected from paddy field in and around Vriddhachalam that regularly throws about 20g to 30g of crab shell per week as waste; we also collected from the live stock we maintain in our laboratory the autotomy detachment of body parts and the molting shell of freshwater crabs connected with lunar cycle. It was cleaned by washing continuously with water

*Corresponding author: muthalagis@gmail.com

to remove all the unwanted dirt from the shell. The cleaned crab shell was kept under the sun for 3-5 days for drying through direct sunlight. After 5th day, the dried crab shell was taken and powdered by crushing in a mortar and pestle or blender. The crab shell powder was kept stored for further mineral analysis such as nitrogen, potassium, phosphorus, calcium and magnesium. Soil sample: The red soil was collected paddy fields while plow; from Vriddhachalam, Cuddalore district. The soil was weighted approximately and was filled in two wide and length pots. In each pot was filled with 5 kg of soil. Seeds: The seeds of *Abelmoschus esculentus* (L.) were collected from plant nurseries of Vriddhachalam. Procedure: About 5 kg of soil is taken in each pot. Holes were made in the pot to prevent from water clogging. The powdered crab shell was taken and weighed 25 gms and mixed in one pot which was labeled as "crab shell powder", the soil sample without crab shell powder was labeled as "Control" another pot is mixed with "Vermicompost". The pot filled with crab shell powder was left for two days before sowing the seeds. After two days of soil filled in pots, the seeds were sown 1 inch deep. *Abelmoschus esculentus* does not require to be buried deep into soil. The seedlings were allowed to grow for one to two months. The pot was kept in enough sunlight and watered everyday to maintain soil moisture content for healthy growth. After week 6, the tubers and leaves of *Abelmoschus esculentus* were collected for nutritional analysis. The NPK values noted to be normal; this is done by to rule out the point that soil nutrients are responsible for the nourishment and growth.

Table 1
Soil analysis report with NPK values of test soil

S.No.	Parameter	Result
1	pH	7.1
2	Nitrogen	1.97
3	Phosphorous	2.5
4	Potassium	2.14

3. Results

The application of freshwater crab shell powder (CSP) demonstrated a significant positive impact on the growth and yield parameters of *Abelmoschus esculentus* compared to vermicompost and the control.

A. Germination and Vegetative Growth

Seed germination was accelerated in the CSP-amended soil, occurring on the third day after sowing, which was one day earlier than in both the vermicompost and control treatments, where germination was observed on the fourth day.

Throughout the vegetative growth stage, plants treated with CSP consistently outperformed the others. As detailed in Table 2, Figure 1 and Plate 1. CSP-treated plants achieved the greatest height by the end of week 6 (20 cm), closely followed by vermicompost (19 cm), with the control plants showing the least growth (14 cm). Furthermore, the number of leaves was consistently highest in the CSP group throughout the growth cycle, reaching 17 leaves by week 6, compared to 15 in vermicompost and 13 in the control.

B. Leaf Morphology

The positive effect of CSP was particularly evident in leaf development. As shown in Table 3 and Figure 2, leaves from CSP-treated plants were substantially larger. By week 6, the average leaf length and width in the CSP group were 9 cm and 10 cm, respectively. This was significantly greater than the leaves from vermicompost-treated plants (5.6 cm length, 5.8 cm width) and control plants (5.5 cm length, 4.5 cm width).

C. Flowering and Yield

The first flowering was observed earliest in the vermicompost treatment (day 36), followed by CSP (day 37), and lastly the control (day 40). Despite a slightly later flowering onset, the CSP treatment resulted in the highest fruit yield. As presented in Table 4, plants amended with CSP produced the highest number of pods per plant (12), with the greatest average pod length (12.2 cm) and average pod weight (11 g). Consequently the total yield per plant was 200 g for CSP, which was 66% higher than the vermicompost yield (120 g) and 142% higher than the control yield (82.5 g). Plate - 2 visually confirms the superior pod production in the CSP-treated plants.

Plate 1. Growth of the plants showed (G) Height of the plant (Week 6)

Plate 2. Yield of the plant - *Abelmoschus esculentus*

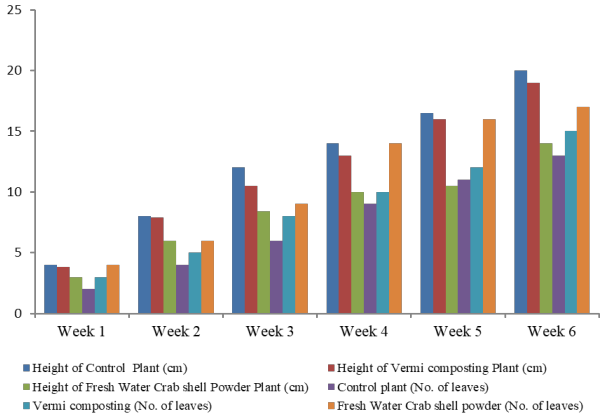

Fig. 1. Height of the plant - *Abelmoschus esculentus*

Table 2
Height of the Plant - *Abelmoschus esculentus*

Week	Height of Control Plant (cm)	Height of Vermi composting Plant (cm)	Height of Fresh Water Crab shell Powder Plant (cm)	Control plant (No. of leaves)	Vermi composting (No. of leaves)	Fresh Water Crab shell powder (No. of leaves)
Week 1	4	3.8	3	2	3	4
Week 2	8	7.9	6	4	5	6
Week 3	12	10.5	8.4	6	8	9
Week 4	14	13	10	9	10	14
Week 5	16.5	16	10.5	11	12	16
Week 6	20	19	14	13	15	17

Table 3
Leaf length and leaf width of *Abelmoschus esculentus*

Measurement of the plant	Control			Vermi composting			Freshwater crab shell powder		
	Week 2	Week 4	Week 6	Week 2	Week 4	Week 6	Week 2	Week 4	Week 6
Leaf Length (cm)	2	4	5.5	2.2	4.5	5.6	2.4	5.2	9
Leaf Width (cm)	1	3.8	4.5	1.5	4	5.8	5.5	5.5	10

Table 3
Ratio of pod length and weight of *Abelmoschus esculentus*

Parameter	Control	Vermicomposting	Freshwater crab shell powder
Number of pods per Plant	5	8	12
Average pod Length (cm)	7.5 cm	10.5 cm	12.2 cm
Average pod Weight (g)	6.8 g	8.9 g	11 g
Total yield per plant (g)	82.5 g	120 g	200 g

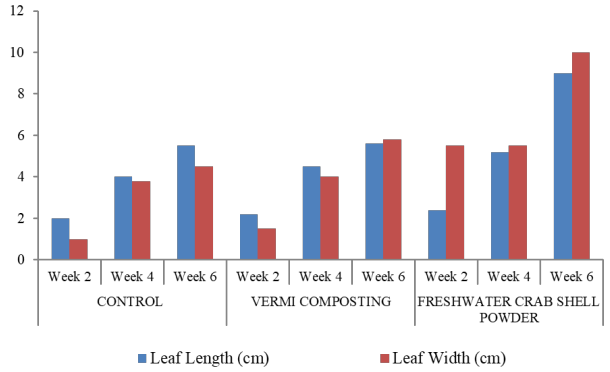

Fig. 2. Leaf length and leaf width of *Abelmoschus Esculentus*

Control soil (no fertilizer) resulted in poor growth and lower yield, demonstrating the importance of the organic amendments. Vermicompost was the more effective growth compared to control soil. Crab shell powder was most effective organic fertilizer enhanced phosphorus, calcium, chitin level and pest resistance, leading to moderate yield.

4. Discussion

Organic farming is one such technique that promotes food safety while also increasing soil biodiversity. As a result the goal of this research is to practice organic farming in order to create more sustainable agricultural systems and boost soil fertility (Anjani *et al.* 2014). Plant extracts, animal byproducts and other natural products are used in organic farming. The current organic fertilizer was chosen from Vyrukshayurveda, versus ash and Cucumber dies if profusely smoked with bones of crabs (Nalini, 1996 and 2004). Reusing trash from the fishing industry is not widespread and a considerable percentage of waste biomass is thrown straight into the environment without treatment.

This form of trash on the other hand is a high - value raw material that can be used to make biocompounds (Rebecca *et al*., 2015). In this research, one type of freshwater trash that is discarded is crab shell which can be utilised as an organic fertiliser to reduce pollution and improve soil chemical composition and plant quality. The essential thing to consider for greater returns in any crop production program is to minimise the cost of production without sacrificing crop yield. This can be accomplished by using organic fertilizer instead of inorganic fertilizer and minimising the amount of inorganic fertiliser used. Organic nutrients are more difficult to obtain since the materials must be degraded and organic nutrients mineralized (Sarva and Giri, 2015) resulting in increased nutritional value. Many species of living organisms are activated by organic manures, which release phytohormones and may stimulate plant growth and nutrients. These organisms require nitrogen for multiplication, which is provided by organic manure. An attempt was undertaken in this approach to compare the performance of *Abelmoschus esculentus* in soil with and without crab shell powder as an organic fertiliser. The outcomes are addressed further down. Crab shell fog as organic fertilizer to increase plants of Cucurbitaceae growth dramatically (Anjani *et al*., 2014) and effect of marine waste on seed germination on pea, green gram and tomato in which crab shell provided plants were germinated soon when compare to prawn+ crab and prawn (Rebecca *et al.*, 2014). In this present study the observation of the germination time and germination percentage of the seeds in test (with crab shell powder amendment) was faster when compared to the seeds in control (without crab shell powder amendment). It depicts that 90% of *Abelmoschus esculentus* seeds were found to be germinated in the pot with crab shell powder amendment (test). Whereas, 65% of seeds were only germinated in the pot without crab shell powder (control).

5. Conclusion

The findings of this study unequivocally demonstrate the high efficacy of freshwater crab (*Oziotelphusa aurantia*) shell powder as a potent organic fertilizer for *Abelmoschus*

esculentus. The CSP amendment consistently outperformed both the vermicompost and control treatments across key metrics, including germination rate, vegetative growth (plant height, leaf number and size) and ultimately, fruit yield and quality. The superior performance is attributable to the rich mineral composition of the crab shells - particularly calcium, phosphorus and magnesium - coupled with the biostimulant and elicitor properties of chitin and its derivatives.

Therefore the valorization of crab shell waste into agricultural inputs presents a compelling, dual-benefit solution. It addresses the environmental challenge of waste disposal from the fishing industry while providing farmers with a low-cost, sustainable and highly effective alternative to synthetic fertilizers. The adoption of crab shell powder can enhance soil fertility, boost crop productivity and contribute to a more resilient and eco-friendly agricultural system. Future research should focus on optimizing application rates for different crops and soil types and on the long-term effects of CSP on soil microbiome health.

References

[1] M. Ali, T. Horiuchi, and S. Miyagawa, "Nodulation, nitrogen fixation and growth of soybean plants (*Glycine max* Merr.) in soil supplemented with chitin or chitosan," *Jpn. J. Crop Sci.*, vol. 64, pp. 100–107, 1997.

[2] S. Anjani, K. Sarva, and A. Giri, "Effect of freshwater crab shell fog as organic fertilizers," *Int. J. Sci. Eng. Res.*, vol. 5, no. 4, pp. 307–314, 2014.

[3] Y. I. Cho and H. K. No, "Effective deproteinization under autoclaving conditions for preparation of chitin," *J. Chitin Chitosan*, vol. 4, pp. 152–155, 1999.

[4] I. A. Hamed, F. B. Özogul, and J. M. Regenstein, "Industrial applications of crustacean by-products (chitin, chitosan and chito-oligosaccharides): A review," *Food Chem.*, vol. 48, pp. 40–50, 2016.

[5] K. K. Hong and Y. L. Mun, "Isolation of chitin from crab shell waste," *J. Korean Soc. Food Nutr.*, vol. 24, pp. 105–113, 1995.

[6] S. Nalini, "Surapalas Vrikshayutveda (The science of plant life by Surapala)," *Agri-History Bull.*, vol. 1, p. 94, 1996.

[7] S. Nalini, Vishvavalladha (Dear to the world: The science of plant life), Agri-History Bull., vol. 5, p. 134, 2004.

[8] J. L. Rebecca, S. Anbuselvi, S. Sharmila, P. Medok, and D. Sarkar, "Effect of marine waste on seed germination," *Int. J. Environ. Agric. Biotechnol.*, pp. 581–584, 2014.

[9] J. L. Rebecca, S. Anbuselvi, S. Sharmila, P. Medok, and D. Sarkar, "Effect of marine waste on plant growth," *J. Appl. Biol.*, pp. 299–301, 2015.

[10] R. N. Roy, A. Finck, G. J. Blair, and H. L. S. Tandon, *Plant Nutrition for Food Security: A Guide for Integrated Nutrient Management*. Rome, Italy: Food and Agriculture Organization (FAO), 2006, pp. 25–42, 92–136.

[11] P. Sahota, J. Woodward, R. Molinari, and J. Pike, "Factors influencing take-up of free school meals in primary- and secondary-school children in England," *Public Health Nutr.*, vol. 17, no. 6, pp. 1271–1279, 2013.

[12] S. Sarva and A. Giri, "Effect of freshwater crab shell fog as organic fertilizer to increase growth of Cucurbitaceae," *Agrotechnol*, vol. 4, no. 1, 2015.