Buckwheat: the natural enhancer in rhizosphere phosphorus

Nearly 49% of the Indian soils is deficient in phosphorus (P). P is immobile in the soil system and fixation is a great problem in acid soil. Only labile pool of P has significance to soil fertility. Also, a good management strategy is required as P is not easily lost or added to the root zone by biological and chemical processes. In organic farming systems (Sikkim is an organic state) P is supplied to soils through recycling of on-farm organic materials, viz. compost, animal manure, and green manure crops[1]. Sustainable management of limiting soil P can be enhanced with buckwheat cultivation. It is mostly grown on acidic and ravine soils and has higher tolerance to soil acidity than any other grain crop. It is an efficient crop in extracting soil phosphorus of low availability from the acid soil, possibly through mechanisms such as root-associated mycorrhizae, root acid, enzyme and organic acid exudation, nutrient scavenging activity, organic ligands, etc. These promote P release and/or compete for P adsorption sites[2]. The crop can acidify its rhizosphere and absorb P which is necessary for metabolic processes. Buckwheat can increase soil-P availability for the next crop rotation only after its biomass is incorporated into the soil mainly from less labile inorganic pool (Ca–P) to the available pool[3]. In acid soil with high aluminium toxicity, P solubilization is accelerated by some organic anion (e.g. tartrate, oxalate) exudates by buckwheat roots and there anions interact with phosphate complexes to increase P in soil solution. This suggests that direct rhizosphere chemical alteration enhances P uptake[4]. Thus, in soil having low-P sustainable management of limiting/fixed soil-P can be enhanced with such wonderful underutilized pseudocereal. Soils of Sikkim are acidic in nature and thus this pseudocereal can be an important natural tool for the researcher to combat soil acidity. This crop helps in soil binding and checks soil erosion during the rainy season by its dense root system and acts as an excellent soil conditioner[4]. Its high fibre residues improve soil aeration and thus encourage different microbial activities, making the soil more friable and easier to cultivate. The prevailing agro-ecological condition of Sikkim is suitable to produce buckwheat on a large scale. Thus, a hidden economic benefit with buckwheat cultivation is that it can improve soil quality and fertility enough to increase the yield on the next crop. As a climate-resilient crop, it has immense potential to change the livelihood of the rural populace. Due to its novel and unique characteristics, to improve the livelihood of the fragile mountain ecosystem for the multi benefits, the North Eastern region is getting support from the Indian Council of Agricultural Research under the All-India Coordinated Research Network on Pottential Crops scheme (http://www.nbpgr.ernet.in/AICRN_on_UC.aspx).

1. Joshi, B. D. and Paroda, R. S., NBPGR, New Delhi, 1991, p. 117.
2. Campbell, C. G., *Buckwheat*, International Plant Genetic Resources Institute, Rome, Italy, 1997. p. .93.
3. Michalová, A., In *Advances in Buckwheat Research. 7*, IBRA, Winnipeg, Canada, 1998, pp. I-88-96.
4. Possinger, A. R., Byrne, L. B. and Breen, N. E., *J. Plant Nutr. Soil Sci*., 2013, **176**, 16–18.

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A need to revive research on sea cucumbers in India

More than 1400 species of sea cucumber are known from global seas[1] with nearly 200 species around Indian waters of which 75 are within 20 m depth, but just 15 are of commercial value[2]. Holothuroids are the second most diverse echinoderm class, with some 200 described genera containing about 1600 extant species[3].

Despite the considerable species biodiversity in India and an early emphasis on sea cucumber farming research, further studies have been stifled by the blanket ban on sea cucumber harvest imposed on 11 July 2001 by the Ministry of Environment and Forests, Government of India notification, exercising powers conferred by sub-section (1) of section 61 of the Wildlife (Protection) Act of 1972 by making further amendments in Schedule I adding Part IV C-Echinodermata. This can be attested by the bibliography on Indian sea cucumbers[4]. Biological knowledge of sea cucumbers in Indian waters is scarce, and not even taxonomic inventories are available, much required for ascertaining the potential pharmaco-therapeutic properties of bioactive compounds and novel drugs. For example, lectin from *Holothuria scabra* termed 'HSL' has been studied recently for its role in immune responses[5], and *Holothuria grisea* agglutinin (HGA) is the first invertebrate lectin with anti-inflammatory effects[6]. In addition, sea cucumbers may contribute to the health of ecosystems. Extirpation of sea cucumbers causes sea-floor hardening, eliminating habitat for other benthic and faunal organisms[7]. Nutrient regeneration mediated by these sediment feeders is vital for reef productivity[8]. Sediment bioturbation[8] as well as the nutrient fluxes mediated by holothurian excretion indicate recycling by holothurians on corals[9]. Given that many reefs in the Indian Ocean region have been severely affected due to man-made stressors like high sedimentation, high levels of pollution and high fishing pressure[10], sea cucumbers may play a vital role in maintaining healthy reefs.

India has varied nuclear power reactor types, releasing radionuclides in the marine environment (sediments and biota)[11]. Radioactive materials taken up by sea cucumbers are organically bound to

proteins and carbohydrates in their organs and tissues; however, the chemical identity and in particular, the molecular structure and biological function of radionuclide-binding proteins are little known[12]. Sea cucumbers can thus serve as bio-indicators for multiple stressors of the Indian Ocean and as regenerators of ocean reef.

The potential for sustainable, profitable and socially equitable, innovative holothurian farming is unlimited for India. Sustainable aquaculture and stock improvement programmes could help restore stocks and Best Management Practices (BMP), and adaptive governance could be implemented to avoid mistakes of past fishery policies. Age and growth analysis is vital for the fishery managers evaluating environmental variability and biological stock conditions while developing sustainable strategies for management[13]. An absence of innovative research on sea cucumbers will certainly deprive our coastline of the benefits of creative nutrient remineralization and regeneration through ranched sea cucumbers[14]. Hence scientific research on Indian holothurians needs to be promoted with special emphasis on sustainable farming techniques, stock enhancement through ranching and biotechnological drug discoveries.

1. James, D. B., *Naga ICLARM Quart.*, 2001, **24**, 4–8.
2. James, D. B., In *Glimpses of Aquatic Biodiversity*, Rajiv Gandhi Chair Spl. Publ., 2008, **7**, 120–132.
3. Smiley, S., In *Microscopic Anatomy of Invertebrates* (eds Harrison, F. W. and Chia, Fu-Shiang) 14, Echinodermata, Wiley-Liss, New York, 1994, pp. 401–471.
4. James, D. B., *Technical Bulletin*, The Fisheries Technocrats Forum, March 2004, Chennai, vol. 2, pp. 1–24.
5. Gowda, N. M., Goswami, U. and Khan, M. I., *Fish Shellfish Immunol.*, 2008, **24**(4), 450–458.
6. Moura, R. M. *et al.*, *Fundam. Clin. Pharmacol.*, 2013, **27**(6), 656–668.
7. Bruckner, A. W., Johnson, K. A. and Field, J. D., *SPC Beche-de-Mer Inform. Bull.*, 2003, **19**, 24–32.
8. Uthicke, S., *Bull. Mar. Sci.*, 1999, **64**, 129–141.
9. Uthicke, S., *J. Exp. Mar. Biol. Ecol.*, 2001, **265**, 153–170.
10. Pet-Soede, L., Wafar, M., Venkataraman, K., Rajan, P. T. and Wilhelmsson, D., In Coral Reef Degradation in the Indian Ocean (CORDIO): Status Reports and Project Presentations, 2000, 2001, pp. 69–74.
11. Regunathan, C. and Kitto, M. R., *Curr. Sci.*, 2009, **96**(1), 12–13.
12. Suzuki, Y., Nakahara, M., Nakamura, R. and Ueda, T., *Bull. Jpn. Soc. Sci. Fish.*, 1982, **48**(10), 1495–1500.
13. Poot-Salazar, A., Hernandez-Flores, A. and Ardisson, P., *Nature Sci. Rep.*, 2014, **4**, article no. 5151, 1-7. doi: 10.1038/srep05151.
14. Giraspy, D. A., Regunathan, C., Jerald Wilson, Marimuthu, N. and Kitto, M. R., *Aquacul. Eur.*, 2012, **37**(3), 23–25.

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Smile with Science

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