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Beach Bean- a Coastal Survivor with a Future in Sustainable Agriculture

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Abstract

Vigna marina, commonly known as beach bean, is an underutilized wild legume naturally adapted to saline and nutrient poor coastal environments. Its remarkable ability to withstand seawater exposure and other environmental stresses makes it a valuable biological resource for sustainable agriculture. This article highlights the ecological significance, salinity tolerance, physiological and biochemical adaptations, genomic resources, symbiotic nitrogen fixation and potential utilization of *Vigna marina*. Its creeping growth habit contributes to sand stabilization and coastal protection, while its association with rhizobia supports survival in nutrient limited habitats. Physiological and biochemical responses further enable the species to maintain growth under severe salinity. Available genomic information and its relationship with cultivated *Vigna* species also indicate considerable potential for exploiting this wild genetic resource in crop improvement. Greater attention to the conservation, characterization and utilization of *Vigna marina* could therefore contribute to developing climate resilient legumes and improving the productive use of saline and marginal environments.

Keywords:

Climate resilience, nitrogen fixation, salinity tolerance, *Vigna marina*, wild legume

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1. Introduction

Along the scorching coastal lines of tropical regions, where most crops fail to survive, a resilient legume quietly thrives -*Vigna marina,* commonly known as beach bean. This underutilised wild relative of major legumes such as mung bean (*Vigna radiata*) and cowpea (*Vigna unguiculata*) is a biological treasure in various aspects particularly under growing threat of soil salinisation and climate change. Unlike conventional vigna species *Vigna marina* flourishes in nutrient poor saline sandy conditions. It is widely distributed across tropical beach sides generally including Southeast Asia, Africa, America and parts of India such as Andaman and Sunderbans of West Bengal (Bhattacharjee et al., 2019). Despite having such remarkable capability, it remains underrated and unnoticed in this era of climate change, rising salinity, and declining arable land. On the other hand, its close relationship with cultivated Vigna species further enhances its importance as donor of stress tolerant traits for crop breeding (Singh et al., 2019).

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2. Ecology and Distribution

Vigna marina is specifically adapted to coastal habitats such as sand dunes and beach zones where environmental conditions are highly dynamic. These habitats impose continuous physical and chemical stress, which has made the crop evolve with special adaptations for establishment and persistence. The species exhibits a prostrate and trailing growth habit and that enables it to spread laterally across loose sandy surfaces and this growth habit aids in stabilizing dunes and reducing soil erosion thereby maintaining the structural integrity of coastal ecosystems. In many other cases, *Vigna marina* functions as an early colonizing species, which facilitate the establishment of other vegetation.

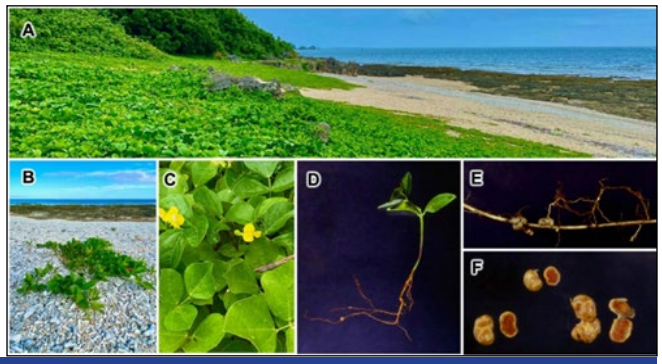

Figure 1: *Vigna marina* in its natural coastal habitat and its morphological features: (A) natural habitat, (B) growth along the seashore, (C) flowers and mature pods, (D) seedling, (E) root nodules, and (F) transverse section of root nodules showing reddish leghemoglobin. Source: Singh et al. (2019)

Figure 2: Seeds of *Vigna marina* float in seawater, while seeds of Vigna radiata and *Vigna angularis* sink, highlighting its unique coastal adapatation. Source: Singh et al. (2019)

There are various ecological features for this species some of the notable characters include the buoyant nature of seeds and ability to disperse through seawater. In addition the species can remain viable after prolonged exposure to saline conditions which allow them dispersal through ocean currents. This mechanism helps them to persist in fragmented and unstable habitats. Apart from structural adaptations, *Vigna marina* contributes to nutrient cycling through biological nitrogen fixation, which improves soil fertility (Singh et al., 2019).

3. Salinity Tolerance and Physiological Adaptations

The predominant characteristic of *Vigna marina* is its exceptional tolerance to salinity. Studies suggest that the species can maintain stable growth and biomass even under high salt concentrations of up to 400mM NaCl. Unlike other conventional crops which exhibit growth inhibition under extreme saline conditions, *Vigna marina* exhibits tolerance mechanism in both morphological and physiological ways. Studies have shown that physiologically chlorophyll a and chlorophyll b contents increase significantly under high salinity, indicating enhanced photosynthetic activity (Septiana and Analuddin, 2019) which accounts for sustained growth and productivity in otherwise unfavourable environments.

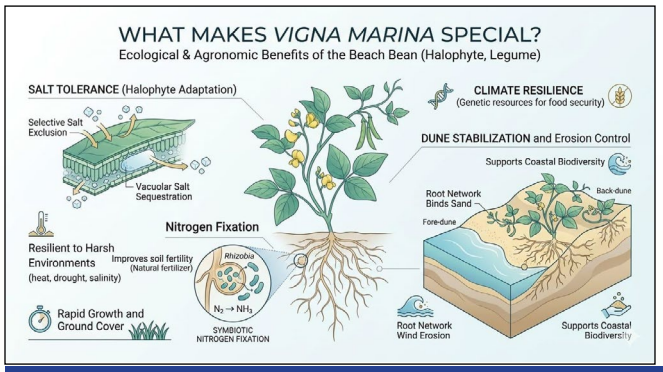

Figure 3: Key ecological and agronomic features of *Vigna marina*

4. Biochemical Mechanism of Stress Resistance

It is a normal fact that salinity stress leads to accumulation of reactive oxygen species(ROS), which inturn damage the cellular components resulting in cell death. *Vigna marina* counteracts this situation through enhanced production of antioxidant compounds. Significant increases in vitamin C, anthocyanins and alkaloids have been observed under elevated salinity conditions (Septiana and Analuddin, 2019). These compounds do play a key role in scavenging out ROS, thus protecting cellular structures and maintaining metabolic balance. Vitamin C functions as a primary antioxidant, while anthocyanins provide photoprotection and reduce oxidative damage. Thus

coordinated increase in these metabolites showcases the plant's ability to activate multiple biochemical pathways in response to environmental stress.

5. Genomic Insights and Breeding Potential

The draft sequence reveals a genome size of approximately 365.6 Mb and more than 50,000 predicted genes, along with large number of molecular markers including simple sequence repeats and single nucleotide polymorphisms (Singh et al., 2019). These genomic resources are considered highly valuable among scientific community particularly for marker assisted selection and genetic mapping. In addition, significant amount of sequence variation was identified when compared with *Vigna radiata* and *Vigna angularis*. Around thousands of single nucleotide polymorphisms and insertion deletion variations have been reported, indicating high level of genetic diversity that can be exploited for crop improvement (Singh et al., 2019). This kind of variability is what breeders are hunting for in present era where pockets of variability is deteriorating at an alarming rate. Further this variability paves way for identifying alleles associated with stress tolerance and environmental adaptation. Genomic analysis further confirms the close evolutionary relationship of beach bean with other *vigna* species providing insights to breed for transfer of useful traits through conventional or molecular ways in future (Tomooka et al., 2011). Apart from these, genomic data analysis provides a foundation for advanced approaches such as quantitative trait locus mapping and genome assisted breeding. These tools can accelerate incorporation of desirable traits from wild to cultivated backgrounds, thereby enhancing crop resilience under adverse environmental conditions.

6. Promiscuous Symbiosis and Nitrogen Fixation

One of the very remarkable ecological and agricultural feature of *Vigna marina* is its ability to establish symbiosis with multiple rhizobial partners rather than relying on specific strains and this ability is known as promiscuous symbiosis which accounts for major adaptive advantage allowing them to survive in marginal, degraded, nutrient poor soils without need for specific inoculation. Studies state that rhizobial strains associated with *Vigna marina* exhibit tolerance to salinity, enabling effective nitrogen fixation even under stress (Elanchezian et al., 2009). Unique traits like this are particularly valuable for low input agriculture.

7. Nutritional and Ethnobotanical Significance

Beyond ecological and physiological importance, *Vigna marina* also holds potential as a food resource. The species produces abundant seeds, which have been recognised as a potential source of nutrition in coastal regions (Septiana and Analuddin, 2019). In Australia, aboriginal people use its root as food . Because it can be grown in sunny areas as a ground cover, it is especially favoured for beachfront properties and prevention of coastal erosion. The latter property, along with its nitrogen-fixing ability, favours the growth of neighbouring plant communities (Singh et al., 2019).

8. Conclusion

Vigna marina is a valuable wild legume with considerable potential for sustainable and climate-resilient agriculture. Its tolerance to salinity, ability to thrive in nutrient-poor coastal habitats, symbiotic nitrogen fixation and rich genetic diversity make it a promising resource for crop improvement. Its ecological role in coastal stabilization further enhances its importance. Greater emphasis on conservation, characterization and utilization of *V. marina* could facilitate the development of stress-tolerant legumes and productive use of saline and marginal environments.

9. References

Bhattacharjee, B., Bhattacharjee, A., Karthigeyan, K., Dey, A., 2019. *Vigna marina* (Fabaceae) – A new addition to the flora of West Bengal. International Journal of Advanced Research in Botany 5(2), 45–47.

Elanchezian, R., Rajalakshmi, S., Jayakumar, V., 2009. Salt tolerance capacity of rhizobium species associated with *Vigna marina*. Indian Journal of Agricultural Sciences 79, 980–985.

Septiana, A., Analuddin, 2019. Potential uses of marine bean (*Vigna marina* Burm.) as salt tolerant legume in coastal salty land, Southeast Sulawesi, Indonesia. IOP Conference Series: Earth and Environmental Science 260, 012142.

Septiana, A., Nakamura, S.P., Naomasa, R.F., Yamasaki, H., 2025. Seawater tolerance of the beach bean *Vigna marina* (Burm.) Merrill in comparison with

mung bean (*Vigna radiata*) and adzuki bean (*Vigna angularis*). Agriculture 15(3), 228. DOI: 10.3390/agriculture15030228.

Singh, A.K., Velmurugan, A., Sen Gupta, D., Kumar, J., Kesari, R., Konda, A., Singh, N.P., Roy, S.D., Biswas, U., Kumar, R.R., Singh, S., 2019. Draft genome sequence of a less-known wild *Vigna*: Beach pea (*Vigna marina*). The Crop Journal 7(5), 660–666.

Tomooka, N., Kaga, A., Isemura, T., Vaughan, D., Srinives, P., Somta, P., Thadavong, S., Bounphanousay, C., Kanyavong, K., Inthapanya, P., Pandiyan, M., Natesan, S., Ramamoorthi, N., Jaiwal, P., Jing, T., Umezawa, K., Yokoyama, T., 2011. *Vigna* genetic resources. In: Proceedings of the 14th NIAS International workshop on genetic resources "Genetics and comparative genomics of legumes (*Glycine* and *Vigna*)", pp. 11–21.