are regarded as waste and unproductive with no worthwhile protection. They are encroached for agriculture and often fragmented by habitations, urbanization, forest fires and invasive species. The habitats are also prone to elimination since many grass species, primarily those of *Cymbopogon*, are harvested as fodder or for thatching by locals. There is likelihood of these species being removed along with them. The edible tubers of the members of this genus and allied genus *Ceropegias*, known variedly as Nematai, Nematigaddalu, Potha Jougu Nimatayalu, Petta Jougu Nimatayalu, Singati galya, are often dug out by the locals. Wild animals, rodents, wild boar and langurs also relish these tubers and thus threaten their natural regeneration.

Many focused publications on endemic and threatened species of India surprisingly omitted this genus as a whole[12,13]. Rao *et al.*[14] and Nayar[15] placed *B. bourneae* under 'indeterminate' and 'possibly extinct' categories respectively. In spite of their rarity and distinctiveness from African *Brachystelma*[16,17], they were neither considered for any focused collection nor attempted for IUCN conservation status. The genus as a whole falls in the most deserving zone for focused conservation. The whole group is to be attempted in a project mode primarily for recollections of all the documented species, taxonomic revision, assessing their distribution in the field and assigning IUCN conservation status, promoting studies on coronal structures, pollination ecology, *ex situ* conservation and rehabilitating them in protected natural habitats by acclimatizing and multiplying them in gardens, thereby giving a whole insight into their taxonomy and conservation. They are true blinking stars of angiosperms and require due care.

1. The Plant List, version 1, published online, 2010; http://www.theplantlist.org/ (accessed on 10 April 2013).
2. Meve, U., In *Illustrated Handbook of Succulent Plants: Asclepiadaceae* (eds Albers, F. and Meve, U.), Springer-Verlag, Berlin, 2002, pp. 20–46.
3. Hooker, J. D. (ed.), *Flora of British India, Vol. 4*, L. Reeve & Co, London, 1883, pp. 64–66.
4. Gamble, J. S., In *Flora of the Presidency of Madras, Vol. 2*, Adlard & Son, London, 1921, pp. 850–852.
5. Duthie, J. F., *Flora of the Upper Gangetic Plain and of the Adjacent Siwalik and sub-Himalayan Tracts, Vol. 2*, Superintendent Government Printing, Calcutta, 1911, pp. 64–65.
6. Rajakullayiswamy, K. *et al.*, *Rheedea*, 2012, **22**(2), 107–110.
7. Vijaya Sankar, R. *et al.*, *Phytotaxonomy*, 2003, **3**, 130–133.
8. Hanumanthappa, K., In *Flora of Andhra Pradesh, Vol. 2* (eds Pullaiah, T. and Ali Moulali, D.), Scientific Publishers, Jodhpur, 1997, pp. 581–582.
9. Sharma, B. D. *et al.*, In *Flora of Karnataka, Analysis* (eds Sharma, B. D. *et al.*), Botanical Survey of India, Howrah, 1984, pp. 164–165.
10. Srinivasan, S. R., In *Flora of Tamil Nadu, India, Vol. 2* (eds Henry, A. N. *et al.*), Botanical Survey of India, 1987, pp. 80–81.
11. Jagtap, A. P. and Singh, N. P., *Brachystelma. Fascicles of Flora of India, Fascicle 24*, Botanical Survey of India, Calcutta, 1999, pp. 178–190.
12. Nayar, M. P. and Sastry, A. R. K., *Red Data Book of Indian Plants, Vol. 1–3*, Botanical Survey of India, Calcutta, 1987, 1988, 1990.
13. Ahmedullah, M. and Nayar, M. P., *Endemic Plants of the Indian region – Peninsular India*, Botanical Survey of India, Caicutta, 1987.
14. Rao, C. K. *et al.*, Red list of threatened vascular plant species in India, Botanical Survey of India, Kolkata and ENVIS Centre for Floral Diversity, Palode, Thiruvananthapuram, 2003.
15. Nayar, M. P., *Hot Spots of Endemic Plants of India, Nepal and Bhutan*, TBGRI, Palode, Thiruvananthapuram, 1996.
16. Meve, U. *et al.*, *Ann. Mo. Bot. Gard.*, 2007, **94**, 392–406.
17. Surveswaran, S. *et al.*, *Plant Syst. Evol.*, 2009, **281**, 51–63.

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P. VENU*
K. PRASAD

Deccan Regional Centre,
Botanical Survey of India,
Hyderabad 500 048, India
**For correspondence.*
e-mail: pvenu.bsi@gmail.com

Multicoloured seed coat and flower in *Abrus precatorius* (Leguminosae), India

There is growing evidence that intraspecific trait variability can play a fundamental role in plant community responses to environmental change and community assembly[1]. Regarding these aspects, variations have been studied in different hierarchical positions, viz. intra familiar relationship[2,3], the evolutionary position of genera[4], the origin and evolution of species[5], and the degree of portioning of cpDNA variation within species at molecular level[5,6]. However, the first report[7] on the morphological variation in size of the leaves of *Calotropis gigantea* was recorded during 1913. Different kinds of climatic races or ecotypes in many species from coast to high altitude, north to south and maritime to inland were studied[8,9], which showed that the ecotypes of different species have parallel variation with regard to both morphological and physiological properties. Biogeographic and phylogenetic studies[10–12] showed that variations are more in higher elevations; rather the variations are low at lower elevations[13].

In India, classical records of intraspecific variations among the angiosperms are available for the last 5 decades. For example, variations in leaf morphology were recorded in *Naravelia zeylanica*, family Ranunculaceae[14] and *Lepisanthes tetraphylla*, family Sapindaceae[15]. Actinomorphic flower form of *Clitorea ternatea*[16], floral asymmetry in

Malavaceae[17], occurrence of tricarpel nature in Rubiaceae[18] and tetra locular fruit in *Cleistanthus collinus*[19] have been documented. Natural variation or hybridization occurring in wild habitats was recorded for the first time in their floras, especially for the families Fabaceae and Acanthaceae[20,21]. However, nowadays the variations and teratological observations from agricultural and horticultural crops are reported daily in newspapers.

During the last two decades of botanical survey from different forest types of the Eastern Ghats and along the Coromandel coast of Tamil Nadu, multicoloured nature of seed coat and flower have been found in *Abrus precatorius*, family Leguminosae. The plant is commonly known as jequirity bean or pea, crab's eye, rosary pea, precatory pea or bean, John Crow bead, Indian licorice, Akar Saga and Jumbie bead. It is an extensive climber, branches wiry and glabrous. Leaves even-pinnate, up to 10 cm long; leaflets 8–20 pairs, oblong, glabrous on both surfaces. Inflorescence terminal or axillary, up to 10 cm long. Petals pale blue. Pod with 4–6 seeds; usually red and black or occasionally white; coat hard and glossy. It commonly grows among bushes and hedges up to 1000 m elevation and is pantropic in distribution. Leaf, seed and roots are used as medicine.

The seed coat of *A. precatorius* is normally red and black; pure white colour is also commonly observed. Single-coloured seed coat, viz. white, green, black, metallic blue, yellow, brown and red and two-coloured seed coat, viz. red and black, white and brown, white and yellow or light brown have been recorded (Figure 1). The normal flower colour is pale blue; moreover, white colour is also found (Figure 2).

There are seven different colours documented in the Siddha literature, but it has not yet been recorded by the scientific community. However, the traditional healers of Tamil Nadu and tribal folk are aware of this. Seeds of four different colours, viz. black, grey, white and red are found to occur only on the hills. The usual seed with red and black coat seems to be poisonous whereas the seed with white skin has been used as medicine since long, due to the presence of less active principle[22]. In Siddha medicine, the oil prepared from the white variety is used as aphrodisiac[23], however, in Ayurveda this oil is said to promote/stimulate hair growth. A tea made from the leaves is used to treat fever, cough and cold. Traditionally, green and blue seeds are considered lucky when one is kept close to the body; so there is demand for these seeds. Owing to the demand, the local tribal community adulterated the blue seeds of *Rhynchosia cyanosperma* (Leguminosae) for the blue seeds of *Abrus* (Figure 3). Sometimes immature seeds are also available in different shades.

Leaves are sweet and edible, however, the seeds are reported to be poisonous. The use of seeds is common among the Lambani community during labour pain for easy delivery[24]. Laboratory studies have shown that the seeds have antioxidant, anti-inflammatory and analgesic potential[25] and antibacterial activities[26,27].

The recent developments and advanced techniques have paved the way to study the morphovariants found among the plants and its parts and they are genetically addressed by using different molecular markers. For example, the

Figure 1. Multicoloured seed coat in *Abrus precatorius*.

Figure 2. Two different flower colours of *A. precatorius*.

Figure 3. *Rhynchosia cyanosperma* – adulterant to blue *A. precatorius*.

intraspecific genetic variability of *Argemone*[28], *Coriandrum sativum*[29], *Mangifera indica*[30] and *Cissus quadrangularis*[31] has been studied. However, earlier studies on inter- and intra-specific diversity were based on locality characteristics, e.g. area, geographical isolation or environmental heterogeneity[32].

The morphovariants in plants such as the nature of tomentum (less or dense), lamina lobes (number, deep or shallow), presence or absence of serration (single or double), and flower and fruit colours need to be studied with respect to temperature, rainfall, humidity, altitude, latitude and longitude across different geographical regions. In addition, phytochemical, pharmacognostic and genetic studies at molecular level need to be significantly correlated with edaphic, climatic and biotic factors. By advanced tools and techniques, the morphovariant of *A. precatorius*, viz. two shades of flower and nine different shades of seed coat needs to be verified at genetic or molecular level. Unless, if it has not been proved the statement 'the survival of individuals and populations are fundamental for all the species and an important aspect of every ecosystem, the aspect of changing intraspecific diversity on predictability and stability of survival has been over looked to date'[33], will be true.

1. Kichenin, E., Wardle, D. A., Peltzer, D. A., Morse, C. W. and Freschet, G. T., *Funct. Ecol.*, 2013, **27**, 1254–1261.
2. Jansen, R. K. and Palmer, J. D., *Am. J. Bot.*, 1988, **75**, 753–766.
3. Lavin, M., Doyle, J. J. and Palmer, J. D., *Evolution*, 1990, **44**, 390–402.
4. Sytsma, K. J. and Gottlieb, L. D., *Evolution*, 1986, **40**, 1248–1261.
5. Soltis, D. E. and Soltis, P. S., *Evolution*, 1989, **43**, 586–594.
6. Soltis, P. S., Soltis, D. E., Wolf, P. G. and Riley, J. M., *Am. Fern J.*, 1989, **79**, 7–13.
7. Chibber, H. M., *J. Bombay Nat. Hist. Soc.*, 1913, **22**, 208.
8. Turesson, G., *Hereditas, Lyonia*, 1922, **3**, 100–113.
9. Turesson, G., *Hereditas, Lyonia*, 1925, **3**, 211–350.
10. Hewitt, G. M., *Nature*, 2000, **405**, 907–913.
11. Taberlet, P. and Cheddadi, R., *Science*, 2002, **297**, 2009–2010.
12. Tribsch, A., *J. Biogeogr.*, 2004, **31**, 747–760.
13. Schonswetter, P., Stehlik, I., Holderegger, R. and Tribsch, A., *Mol. Ecol.*, 2005, **14**, 3547–3555.
14. Siddiq, E. A., *J. Bombay Nat. Hist. Soc.*, 1962, **59**, 325–327.
15. Leenhouts, P. W., *Blumea*, 1969, **17**, 33–91.
16. Saroja, T. L., *Bull. Bot. Surv. India*, 1962, **3**, 409–410.
17. Davis, T. A. and Selvaraj, J. C., *J. Bombay Nat. Hist. Soc.*, 1964, **61**, 402–409.
18. Singh, T. C. N. and Kalyanasundaram, S., *J. Indian Bot. Soc.*, 1953, **32**, 64–66.
19. Kumari, G. R., *J. Bombay Nat. Hist. Soc.*, 1968, **65**, 269–270.
20. Saldanha, C. J., *Flora of Karnataka*, Oxford & IBH, New Delhi, 1996, vol. 1, p. 452.
21. Matthew, K. M., *Flora of Tamil Nadu Carnatic*, Rapinat Herbarium, Tiruchirapalli, 1983, vol. 3, pp. 1154–1157.
22. Mishra, A., M Sc thesis, Department of Life Science, National Institute of Technology, Rurkela, 2012.
23. Raamachandran, J., *Herbs of Siddha Medicines: The First 3D Book on Herbs*, 2008, vol. 2, p. 9.
24. Ganesh Babu, N. M., Ph D thesis, Discipline of Forest Botany, Forest Research Institute University, Dehra Dun, 2011.
25. Arora, R., Gill, N. S., Kaur, S. and Jain, A. D., *J. Pharmacol. Toxicol.*, 2011, **6**, 580–588.
26. Kekuda, T. R., Vinayaka, K. S., Soumya, K. V., Ashwini, S. K. and Kiran, R., *Int. J. Toxicol. Pharmacol. Res.*, 2010, **2**, 26–29.
27. Roy, R., Acharya, R., Narayan, C., Mandal, I., Barman, S., Ghosh, R. and Roy, R., *Ancient Sci. Life*, 2012, **32**, 20–23.
28. Karnawat, M. and Malik, C. P., *Nucleus*, 2011, **54**, 153–158.
29. Pareek, N., Jakhar, M. L. and Malik, C. P., *Phytomorphology*, 2013, **63**, 1–9.
30. Jena, R. C., Samal, K. C., Chand, P. K. and Das, B. K., *Plant Tissue Cult. Biotechnol.*, 2010, **20**, 91–99.
31. Kaur, R. and Malik, C. P., *Phytomorphology*, 2013, **63**, 113–118.
32. Vellend, M. and Geber, M. A., *Ecol. Lett.*, 2005, **8**, 767–781.
33. Gamfeldt, L. and Kallstrom, B., *Oikos*, 2007, **116**, 700–705.

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N. BALACHANDRAN*
K. RAJENDIRAN

Department of Botany,
KM Centre for Post Graduate Studies,
Lawspet,
Puducherry 605 008, India
**For correspondence.*
e-mail: nbala_plant@yahoo.co.in

Orbicular structures near Pichhore, Shivpuri district, Bundelkhand Craton: forerunner for geoheritage site

Geoheritage sites are places that possess imprints of geological processes in the past with unique and interesting geological features. They generate inevitable interest among geoscientists and common people alike. Since its inception 4600 million years ago, Earth has been evolving to attain its present conditions. During this course of evolution, many places become scientifically important in providing vital links in the form of rocks, minerals, fossils, flora–fauna, various landscapes, etc. Keeping these in mind, it is our responsibility to identify and preserve such scientifically important and aesthetically beautiful sites (such as stratigraphic sections with important rock types, tectonic locations, fossil sites, ancient mining sites, canyons, valleys, deltas, springs, etc.). Effective mechanisms with the help of government agencies should be developed to protect these sites from the effects of mining, excavations, urbanization, real estate activities, industrialization, agriculture and natural degradation. Preserving these sites will also open a new window for our future