Genetic resources for EFSB resistance in brinjal

The excessive use of insecticides, in order to keep the eggplant fruit and shoot borer (EFSB) under control in India, is a major concern. The development of genetically modified, pest-resistant brinjal hybrids known as *Bt* brinjal has been offered as an alternative strategy in combating the pest.

Ranjithkumar *et al.*[1] report the lack of EFSB resistance in brinjal (*Solanum melongena* L.) germplasm and thus the difficulty in developing resistant cultivars by traditional plant breeding methods. No commercial cultivars with appreciable levels of resistance have yet been developed, but this may be due to inadequate screening which took place about 10–20 years ago[2]. Furthermore, our understanding of the precise mechanisms involved in host-plant EFSB resistance has increased in recent years[3,4], and this may allow a more focused search for suitable germplasm in future studies. Several non-commercial, resistant brinjal landraces have nevertheless been identified[2,5–8].

The resistance in traditional Indian brinjal landraces, which are genetically close to *S. incanum* L. (the putative progenitor of brinjal), may prove fruitful, as this wild species itself displays EFSB resistance[9]. In this connection, resistant, local brinjal forms have been identified in northwest India[8] and, interestingly, this is the region in which, according to some authors, domestication of brinjal from *S. incanum* is believed to have taken place[10]. Furthermore, brinjal landraces may sometimes be cultivated in small plots, without the use of pesticides (Figure 1). If EFSB attacks the crop, then the selective advantage of any resistant brinjal genotypes is more likely to be manifested, compared with the situation whereby plants of a susceptible, commercial cultivar are cultivated intensively with pesticides. Thus, the incidence of resistance in landraces merits further scrutiny.

Figure 1. Pest damage to brinjal landrace: fruits are of no market value (photograph courtesy: Short Heinrichs, IPM CRSP).

Many brinjal wild relatives have been insufficiently studied, but have great potential as sources of useful genes[11,12], primarily for crop improvement breeding programmes. Of these, around 50 Old World *Solanum* species have yet to undergo first-time crosses with brinjal[13]. *S. melongena* is taxonomically placed in *Solanum* subgenus *Leptostemonum* (the 'spiny solanums'), section *Melongena*. Interfertility between brinjal and several other species in section *Melongena*, and some in section *Oliganthes*, has been demonstrated[13]. Measurable levels of cross-compatibility between brinjal and *Solanum* species in five other sections have also been described. In addition, there is considerable potential for indirect gene exchange with brinjal via the complex inter-relationships between species that may not be interfertile with brinjal but are capable of interbreeding with other species[14]. Such 'bridge species' may hold the answer to solving some of the difficulties resulting from crosses between brinjal and resistant relatives such as *S. sisymbriifolium* (section *Cryptocarpum*), whereby the fitness of the hybrid progeny tends to be unworkably low.

Variation within the spiny solanums is typically very broad, and screening for pest resistance in brinjal wild relatives should be based on the examination of fully representative samples taken from diverse locations. Resistance may vary considerably from one population to another[15]. In addition, more rigorous screening programmes could be employed. For example, general screening could be followed by thorough study of prospective taxa using the insect challenge inoculation technique[16]. When more detailed data on EFSB resistance in wild species have been collected, it will be possible to quantify the overall potential for developing resistant brinjal cultivars through traditional plant breeding methods. To date, around ten EFSB-resistant wild relatives have been identified[2,15] and, fortunately, almost all are from taxonomic sections with species showing breeding compatibility with brinjal. Some have already been incorporated into hybridization studies which investigate the transference of resistance to brinjal[9,17,18]. Several of these studies are on-going and continue to assess the augmentation of fertility and yield in the hybrids, whereby they may attain full commercial potential.

The basis of pest resistance in brinjal and its relatives involves a variety of factors, which probably work together. Naturally occurring pest resistance may mean that a build-up of infestations is more likely to be deterred at an early stage, compared with the action of pesticides. These are often applied to crops with pest populations that have already been established. The risk of the build-up of resistance in target pest populations, and the destruction of non-target arthropods, have been highlighted recently as concerns relating to the excessive use of pesticides and the introduction of transgenic *Bt* crop varieties. Such risks could be considerably reduced if the management of EFSB were to operate via untransformed resistant host plants.

1. Ranjithkumar, L., Patil, B. V., Ghante, V. N., Bheemanna, M. and Arunkumar, H., *Curr. Sci.*, 2013, **105**(3), 366–371.
2. Srinivasan, R., *J. Biopestic.*, 2008, **1**(2), 105–112.
3. Korsheduzzaman, A. K. M., Alam, M. Z., Rahman, M. M., Mian, M. A. K. and Mian, M. I. H., *Bangladesh J. Agric. Res.*, 2010, **35**(1), 149–155.
4. Prabhu, M., Natarajan, S., Veeraragavathatham, D. and Pugalendhi, L., *EurAsian J. BioSci.*, 2009, **3**, 50–57.
5. Alam, S. N. *et al.*, Technical Bulletin No. 28, Asian Vegetable Research and Development Centre, Shanua, Taiwan, 2003.
6. Doshi, K. M., Bhalala, M. K., Kathiria, K. B. and Bhanvadia, A. S., *Capsicum Eggplant Newsl.*, 2002, **21**, 100–101.
7. Jhala, R. C. *et al.*, In Proceedings of the National Symposium on Recent Advances in Integrated Pest Management of Brinjal Shoot and Fruit Borer, Indian Institute of Vegetable Research, Varanasi, 3–4 October 2005, pp. 39–43.
8. Mathur, A., Singh, N. P. and Singh, S., In International Conference on Clean and Green Energy IPCBEE, IACSIT Press, Singapore, 2012, vol. 27, pp. 93–97.

9. Behera, T. K. and Singh, G., *Indian J. Hortic*., 2002, **59**(1), 62–66.
10. Samuels, J., In *Breakthroughs in Genetics and Breeding of Capsicum and Eggplant* (eds Lanteri, S. and Rotino, G. L.), Proceedings of the XV Meeting on Genetics and Breeding of Capsicum and Eggplant, Turin, Italy, 2–4 September 2013, pp. 253–261; https://docs.google.com/file/d/0B9rWkibxVFnpc0NwYTRIZXpydjA/edit?usp=sharing
11. Barendse, G. W. M. and van der Weerden, G. M., In *Solanaceae IV: Advances in Biology and Utilization* (eds Nee, M. *et al.*), Royal Botanic Gardens, Kew, 1999, pp. 361–367.
12. Daunay, M.-C., Bletsos, F., Hennart, J. W., Haanstra, J. P. W. and van der Weerden, G. M., In *Breakthroughs in Genetics and Breeding of Capsicum and Eggplant* (eds Lanteri, S. and Rotino, G. L.), Proceedings of the XV Meeting on Genetics and Breeding of Capsicum and Eggplant, Turin, Italy, 2–4 September 2013, p. 231; https://docs.google.com/file/d/0B9rWkibxVFnpc0NwYTRIZXpydjA/edit?usp=sharing
13. Daunay, M.-C. and Hazra, P., In *Handbook of Vegetables* (eds Peter, K. V. and Hazra, P.), Studium Press LLC, Houston, Texas, 2012, pp. 257–322.
14. Samuels, J., In *Environmental Pollution and Biodiversity* (eds Bharti, P. K., Chauhan, A. and Kumar, P.), Discovery Publishing House, Delhi, 2012, pp. 309–321.
15. Babu, B. S., Pandravada, S. R., Kamala, V. and Sivaraj, N., *J. Entomol. Res.*, 1997, **21**(1), 35–38.
16. Hanur, V. S., Reddy, P. V. R., Boopal, K., Srividya, K. N., Poovarasan, S., Bhalewar, S. and Saraswathi, M. S., *Curr. Sci.*, 2011, **101**(11), 1427–1429.
17. Prabhu, M., Natarajan, S. and Pugalendhi, L., *Indian J. Agric. Res*., 2011, **45**(3), 249–252.
18. Pugalendhi, L., Veeraragavathatham, D., Natarajan, S. and Praneetha, S., *Electron. J. Plant Breed.*, 2010, **1**(4), 643–648.

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