

for molecular biologists, but readers should be aware of what is left out.

This is mainly an ideas book, and Lynch openly makes clear that the main idea he is advocating is a lesser role for selection than is often found in the literature on genome evolution, and greater importance of fixation in species of deleterious changes that selection is unable to prevent. Many of the ideas are controversial, and many are currently under debate in the evolutionary community, and it is a valuable contribution to present them in an accessible manner, and set them in the context of the relevant population genetics theory. Lynch's evident bias in favour of his view is plain enough that it is not likely to impede progress in testing other ideas. Rather, the book is likely to create fruitful debates, and be valuable in getting assumptions clear, and helping create a focus on the most important issues, and thus contribute to beginning to understand many aspects of genome evolution.

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Plant Breeding and Biotechnology. D. Murphy. Cambridge University Press. 2007. 410 pages. ISBN 9780521530880. Price £29.99 (paperback). ISBN 9780521823890. Price £70.00 (hardback).

The success of plant breeders in improving the productivity of the major crop species has been an important factor in enabling the large increases in world population and food availability over recent decades. Accompanied by changes in farming practice, including fertiliser and pest and disease control, average yields have been increased many times over during the past century. Classical cases include the development of hybrid maize in the USA, improved wheat varieties by institutes in Europe such as the Plant Breeding Institute at Cambridge (PBI), and the 'green revolution' facilitated by development of new varieties of

wheat and rice by breeders at the International Maize and Wheat Improvement Centre Mexico (CIMMYT) and the International Rice Research Institute (IRRI) in the Philippines.

Most of the genetic improvement has been obtained by classical methods of selection on yield, on straw strength allowing heavier use of fertilisers, and on disease and stress resistance, aided by incorporation of genetic material from diverse sources. Most of the improvement has been undertaken in publicly funded research stations, for example in the USA by USDA and State Experiment Stations, and by PBI, CIMMYT, IRRI and others. The notable exception has been maize improvement where large commercial breeding companies have operated for over half a century, but Denis Murphy points out that their efforts have been greatly enhanced by support in terms of provision of technology and germ plasm by publicly funded researchers. In the UK and, following the British lead, elsewhere there has been substantial privatisation in the last few decades: for example the Agricultural Research Council's PBI was privatised in 1989 and subsequently sold on to a series of international companies.

Commercial breeders need to recoup their investment through continued income from a good variety, but the farmer can save his own seed for new planting. In maize the market was developed by the need for breeders to return for hybrid seed each year. In Europe and elsewhere this has come from legislation giving plant breeders rights to income on marketed seed down the multiplication chain. The strongest route is via patenting, and the opportunity to patent the product has been a major stimulus to the development of GM varieties, with the biggest success so far being in development of herbicide resistance varieties to reduce growing costs. Murphy is critical of the hype attached to the GM developments, which he points out are really only an extension of the introgression techniques long used by breeders to bring in useful genes or gene combinations from other stocks. He also argues that much of the public antipathy has been because the GM crops have been developed by very large companies such as Monsanto, and have, with minor exceptions, been for traits of importance to the producer and not the consumer. (The notable exception was 'Flavr SavrTM' tomatoes but, they were not a commercial success.) Ignorance of the biology by the popular press and limited but publicised experiments contributed. Even so, Murphy is concerned that the benefits of GM technology have been overstated, arguing they are no more than another tool in the breeders' arsenal such as introgression using marker assisted selection. Albeit he is mostly thinking of incorporation of genes rather than gene construction, but that is for the future and his perspective is rather limited.

Although there is substantial expenditure on plant breeding by the industry much of this is channelled to developing molecular tools and GM products. Murphy's main concern is the decline in the publicly funded plant breeding research and improvement and the impact this will have on crop development, both in the developed and developing world. Quantitative genetic technology has become unfashionable, for example, despite its obvious utility. In contrast, the work on plant genetics in the universities and research institutes has increasingly been at the basic science forefront, using mainly *Arabidopsis*, and a profound increase in understanding, for example of plant development, has resulted. Although the technology has been picked up by the commercial breeders, it has not had great impact on plant improvement. Murphy draws the contrast between this academic research and the work of Borlaug in Mexico in developing modern wheat varieties. Murphy calls for reinvestment by governments in plant breeding research, particularly in countries such as the UK where there is essentially no public funding, whereas there still is in the USA. Other requirements are to improve crops of local importance or for developing countries, activities unattractive to industry. He is also concerned about the insecurity of the world germ plasm resources, which are publicly funded but of value to industry.

In the area of which I have more knowledge, animal breeding, there has been almost no publicly funded breed development within the US and UK for many decades, although government funded major activities such as importation of prolific Chinese breeds of pigs. There is support in the US for genetic evaluation in dairy cattle by the USDA, for example, but public investment in poultry breeding is tiny in relation to the size of the industry. Many fewer animal than plant species are important and there is no strong call for actual breeding rather than basic research to be funded by the public sector. FAO funds breed development and conservation work throughout the world, but these disparate activities may not be really effective. So while I think Murphy makes a strong argument for plants I do not see much of a case in livestock.

This is a thought provoking read. It is not a genetics text, but provides a lot of background for funders and politicians, and it is to be hoped will be read by those in positions of influence. Whether his arguments will have an impact in plant improvement remains to be seen, but there has been a recent tightening of world food supply, so perhaps the funding climate as well as the natural climate will change.

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