

**Sustainable Aquaculture – Global perspectives.** B. B. Jana and Carl D. Webster (eds). Food Products Press, Imprint of the Harworth Press Inc., 10 Alice Street, Binghamton, NY 13904-1580, USA. 2003. 365 pp. Price: US \$ 34.95.

The book under review elucidates comprehensively the global perspectives towards achieving sustainable aquaculture. The book covers thirteen contributed papers, including Indian aquaculture in general, soil and water quality management, pond fertilization, nutrient recycling in temperate climate, nutrition and larval fish feeding of marine fish, fish breeding, indigenous hormonal sex-reversal, diseases of tropical fish, applied nutrition aspects of freshwater prawn culture and with a coverage on grow-out production and carp and the potential and sustainable aquaculture in India. The paper by K. Gopakumar on Indian aquaculture discusses in brief the status and future needs of various production systems of which the crustacean fishery has been dealt with systematically. However, mention on non-fishery resources like seaweed culture has not been attempted.

The paper on soil and water quality management in shrimp pond by C. E. Boyd, is highly informative. Suggestions to overcome the problems are 'good tips' for the farming community. The state-of-the-art on pond fertilization regimen written S. K. Das and B. B. Jana summarizes the role of various nutrients like NPK and P : N, C : N and C : N : P ratio on the pond productivity via administering both the organic and inorganic fertilizers. The paper on recycling of nutrients from wastewater by Juerg Staudenmann and Ranka Junge-Berberovic, on the otel-fingen pilot project-recycling of nutrients from wastewater in a temperate climate, Switzerland gives an insight into treatment of wastewater and subsequent use for fish culture. Considering the growing awareness on aquatic pollution from fish culture as such, this paper has succeeded in demonstrating wastewater recycling for aquaculture in temperate climate.

A review on nutrition of marine fish larvae has been made by Akio Kanazawa, on proteins, lipids, carbohydrates, vitamins and the importance of microencapsulated diets in fish larval rearing. A review is available on important ecological and ethological perspectives in larval fish feeding by T. Ramakrishna Rao. An

account of nutritional requirements of freshwater prawn (Scampi), *Macrobrachium rosenbergii* has been provided by Mukhopadhyay *et al.*, in their paper on 'Applied nutrition in freshwater prawn *Macrobrachium rosenbergii* culture'.

The need for long-term biologically, ecologically and sociologically sound breeding goal is the key factor for sustainable aquaculture. A review on responses of fish and shellfish in temperate and tropical climate is a welcome addition in this book by Olesen *et al.*, in their paper on 'Breeding programs for sustainable aquaculture'. The paper by T. J. Pandian and S. Kirankumar on 'Recent advances in hormonal induction of sex-reversal in fish' drew attention towards the immersion technique of administering steroids, which is cost-effective compared with administering through diets.

The book covers a good deal about diseases affecting fish in tropical environment. Karunasagar and his co-workers have covered many diseases caused by bacteria, fungi and virus, with a note on immunoprophylaxis of fish diseases.

Ayyappan and Jena, in their paper on 'Grow-out production of carps in India', have provided the present status of carp culture in ponds and tanks, cages and pens-integrated fish farming and sewage-fed fish culture.

World aquaculture is in the doldrums owing to heavy capital inputs and intensification in farming practices for sustainable production. Aquaculture wastes generated and consequent aquatic pollution have threatened the existence of farming systems. Issues pertaining to sustainability and strategies for judicious use of its potentiality are well-addressed in the paper on 'The potential and sustainability of aquaculture in India' by Jana and Santhana Jana. The book closes with a paper on 'Freshwater pearl culture technology development in India' by Janakiram. The much-needed topics like edible oysters, clams and mussel farming, however, have not been dealt with.

The appealing cover page, well-set readable font size and well-documented adequate citations of references are the highlights of this book.

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**Dangerous Liaisons? When Cultivated Plants Mate with their Wild Relatives.** Norman C. Ellstrand. The Johns Hopkins University Press, 271S, North Charles Street, Baltimore, Maryland 21218-4363 USA. 2003. 244 pp. Price: US \$ 65.

Plants are fixed to the location where they start their life with sprouting of the seed, and unlike animals, cannot freely roam around to disperse their genes to distant populations. Conversely, the flowering plants produce pollen grains that are the male sex cells with haploid chromosome number, carrying the unique combination of genes present in the individuals. Plants have evolved different mechanisms to disperse their pollen far and wide. They attract insects by brightly coloured flowers, fragrances or nectar. Some attract birds or even bats. These visitors carry with them the pollen when they leave, and deposit the same on the stigma of the flower(s) on the next call. Others produce large amount of pollen that is blown away with the wind, to reach the counterpart haploid female embryo sac in the ovule, to enable the formation of diploid seed. Many species are self-pollinated, while others are cross-pollinated. However, out-crossing is ubiquitous in both self and cross-pollinated species. In the past out-crossing received little attention, except from those engaged in seed production.

In recent years, with the development of transgenic genetically engineered (GE) or erroneously referred to as genetically modified (GM) crop plants, the possibilities of out-crossing and consequent gene flow, defined as the movement of genes from one population to another, have drawn the attention of plant scientists in different disciplines. The book under review is the first comprehensive scientific account of an old phenomenon of out-crossing, well known to plant breeders. The book mainly deals with natural crossing between crop plants and their wild relatives. Gene flow between different cultivars of the same species is not considered. The book is aimed to provide scientific information on the question of gene flow in the highly emotional and controversial issue of GE crops. The author has clearly pointed out in the Preface, 'the simple fact that any new technology has the potential for solving problems, but no technology is without the potential for some negative impact'. This is the real message

of the book based on hard scientific data of out-crossing, gene flow and its consequences. The examples cited are from traditional crop plants domesticated and selected by humans. The implications of the information for the transgenics, produced by human intervention, are examined in the last two chapters.

The book is in four parts incitingly titled – Foreplay, Caught in the Act and Dangerous Liaisons – to catch the attention of the readers. The first chapter in part I titled ‘The Case of the Bolting Beets: Long-Distance Romance’, introduces the problem of bolting (flowering) plants in beet (*Beta vulgaris* ssp. *vulgaris*) crop in Europe. Beetroot is a biennial plant that produces the succulent root in the first year which is harvested, and processed to manufacture sugar. If left in the field, flowers are produced during the second year. A few years ago, high frequency (8 out of 100,000) of bolters started showing up in beet fields, each bolter producing as many as 20,000 seeds creating a seed bank of undesired bolters in the fields. It was extremely difficult to get rid of the bolters, except through manual labour. This story continues in chapter 6.

Chapter 2 introduces the subject of hybridization and gene flow. Chapter 3 deals with natural hybridization among plant species. This chapter brings out the fact that it is not unusual to find plants that appear to be hybrids when related species occur in close or mixed populations. Examples of speciation due to the formation of hybrids, and evolution of allopolyploids are cited. The evolutionary consequences of gene flow, and its implications in theory are examined in chapter 4 along with some observed cases. The gene flow could be neutral, beneficial or detrimental. Mutations are the other source of variation in the populations that could also have similar effects. Unless the gene flow is less than or equal to that of the mutation rate, gene flow would overwhelm mutation effects. In the hybrids of bread wheat, radish, rapeseed and sunflower hybrid-fitness shows either no difference or is much less or greater in comparison to the wild parent.

Part II titled ‘Caught in the Act’, has four chapters (5–8). Chapter 5 deals with recognition of natural hybrids and describes how cultivar-specific markers were found in the wild beet (*Beta vulgaris* ssp. *maritima*) populations close to the seed production plots. These markers were absent from distant populations. It is

important to note that the wild plants that received genes from the cultivated beets did not appear to be more weedy than the natural populations. Earlier, the crop – wild species hybrids were recognized on the basis of their intermediate phenotype and sterility. Subsequently, chromosomal and genetic markers such as allozymes were used. Presently the DNA-based markers provide the most sensitive methods, increasing the confidence in confirming the hybrids. Chapters 7 and 8 raise, and provide answers to, two important questions – Do important crops mate with wild relatives? Is natural hybridization with wild relatives the rule for the domesticated plants (chapter 8)? The answer to the first is that almost 90% of the 25 most important crop plants hybridize with one or more of their wild relatives. The domestication process does create barriers to reduce hybridization between the two species. Thus, the extent of hybridization and introgression of genes is dependent on the species, and other factors. In some hybridization may not occur at all, while in others it may be restricted to the formation of first-generation hybrids. On the other hand, ‘crop–weed–wild complexes’ are reported to occur for beet in Europe, maize in Mexico, radish in California and soybean in Japan.

Part III that carries the title of the book ‘Dangerous Liaisons’ includes four chapters. Chapter 9 examines the impact of the flow of domesticated alleles into wild populations. Examples are collated to show increased diversity of the introgressed populations, stabilization of the populations, especially when the species can propagate vegetatively, development of amphiploids, and new taxa. In the other set of examples, hybridization with the cultivated types has led to the extinction of the wild species. It is hard to find non-introgressed populations of wild rice *Oryza nivara* in East Asia, and *O. rufipogon* ssp. *formosana* is nearly extinct in Taiwan. Finally, in chapter 10, the mystery of the bolting beets is solved. Scientific studies showed that the weedy beets are hybrids or descendent of hybrids that are formed in the seed-production fields due to pollen coming from the wild populations. Consequently, standards for seed production have been raised and seed lots with more than 0.1% bolters during testing are rejected.

Chapter 11 deals with the problem of genetically engineered plants and escape of transgenes from the engineered crops.

The major concerns with the possible transgene flow are (i) evolution of superweeds, (ii) increased risk of extinction, (iii) threat to the genetic diversity of the wild populations, and (iv) hazards of genetic pollution. These issues are discussed, raising the question whether the process (recombinant DNA technique) makes such plants ‘special’ and different from those produced by conventional selection and breeding methods. The transgene could also be a synthesized DNA sequence not found in any organism. The conclusion is that transgenes will not be different from genes in the traditionally bred cultivars. Therefore, it is important to consider the possible effect of the gene(s), irrespective of the method used, and extending the same reason to the introduction of exotic species.

Chapter 12 discusses two main issues: (i) to release or not to release, not only the transgenics but also the exotic species, and (ii) management of gene flow after release. Different physical, ecological and genetic methods that are available to limit gene flow are discussed. Post-release containment and monitoring mechanisms are expensive. Hence, the possible consequences of gene flow should be carefully examined in depth before permitting release. While enhanced agronomic traits may not have significant negative effects, extreme precaution will be necessary for the release of plants genetically engineered to produce pharmaceutical products – the so-called molecular farming.

It was nice to see a citation of the Indian paper of B. B. Dave published in 1943. Dave, a former rice breeder at Raipur (then Central Provinces, now Chhattisgarh), had developed purple-pigmented rice cultivars for the region to easily distinguish cultivated rice from weedy *Oryza sativa* f. *spontanea* in early stages of the crop. After few years of cultivation of purple-rice, the weed also acquired the pigmentation due to introgression of the genes from the cultivated types. This brings the reviewer to the vast potential for gene-flow studies in the country with rich biodiversity, especially of rice and related species in the eastern parts. In this area only the consequences of the past actions, analysed using the modern scientific tools, can provide guidelines for the future. The botanical gardens that have introduced many exotic species can also study the impact of the introduction of whole genomes on the native species, if any, on a scientific basis.

The National Bureau of Plant Genetic Resources may also consider the possible impact of introducing exotic species of agricultural importance.

The book is excellent and easy to read. It may be useful to plant molecular biologists involved in genetic engineering, plant breeders, ecologists, environmen-

talists, and those concerned with biosafety issues. Even anti-GE activists would benefit from this book if they recognize what has been going on in nature before the advent of transgenic crops. Appropriate quotes are given at the start of each chapter; the one from G. Ledyard Stebbins, 'Occasional hybridization between

recognizable species . . . is the rule in flowering plants', sums up the theme.

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