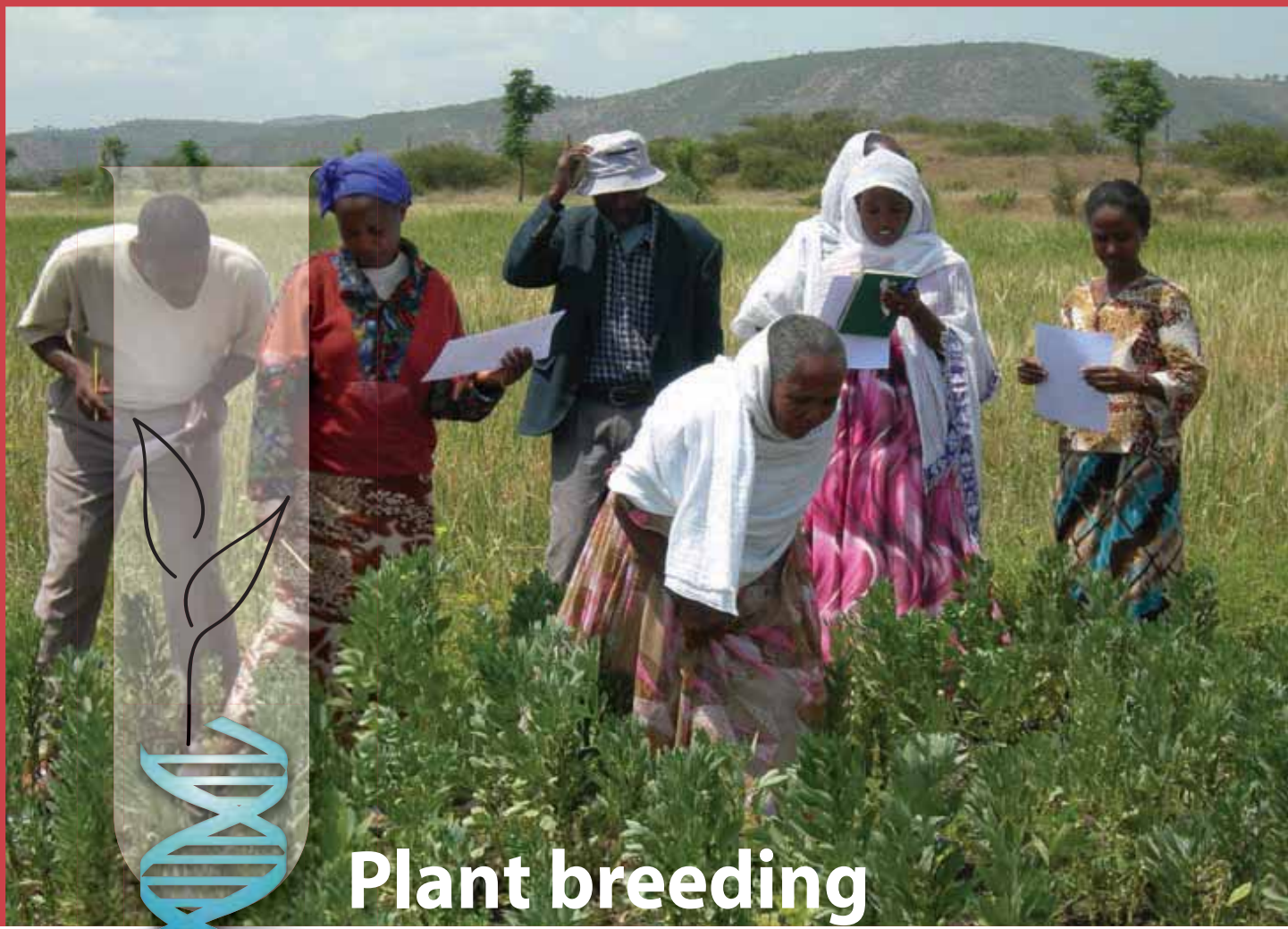


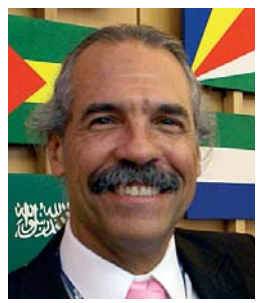
Plant breeding
and farmer participation

ICRISAT

ICARDA

FAO
FIAT PANIS

Plant breeding and farmer participation



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Contents

Foreword

Participatory Plant Breeding (PPB) originated in the early 1980s as part of a movement promoting the concept of participatory research, in response to criticisms of the failure of post-green-revolution, experiment-station-based research to address the needs of poor farmers in developing countries. Rooted in debate over the social consequences of the narrow focus of the scientific type of research, PPB gained recognition as an activity mostly promoted by social scientists and agronomists based in anti-establishment non-governmental organizations (NGOs). In consequence, rather than being perceived from the beginning as an additional option available to breeders, PPB for a long time had the image of being one of two contrasting types of plant breeding, with PPB being more "socially correct" than conventional plant breeding.

Even now, nearly thirty years later, this view is still common. Few professional breeders accept that farmers can be full partners in a plant breeding programme, even though everyone agrees that it was farmers that domesticated crops about 10 000 years ago and, in some regions of the world, continued to modify and manipulate them to the present day. Even before the re-discovery of Mendel's laws of inheritance, the work of a number of amateur breeders become an inspiration for Darwin's theories. In several respects, the relationship with farmers on which PPB is based is similar to the ways in which plant breeders worked with producers in North America and Europe in the early twentieth century. At that time it was commonplace for breeders to spend time interacting with producers, and to test new materials collaboratively in farmers' fields in order to understand what producers considered to be desirable traits for an improved variety. However, the combination of industrialization of agriculture and formal training for plant breeders created a gap between breeders and farmers, a gap that was exported to developing countries in the post-war era. As the profession of plant breeding lost the habit of interacting closely with producers, concern for how to address farmers' needs and constraints fell by the wayside. PPB revived this as a central issue, because by the late 1970s it was increasingly evident in developing countries that post-green-revolution "improved" varieties were too often failing to satisfy farmer requirements and were being shunned.

Today there is widespread recognition that the conventional package of new varieties and external inputs, while successful in the more favourable production areas, has often failed to benefit small-scale farmers in marginal areas. As a result, the vital role of PPB as an additional strategy is better understood. Experience has taught that PPB is complementary to conventional plant breeding rather than an alternative type of plant breeding. Demand for a complementary approach has expanded considerably because of pressure to ensure the relevance of research to poor farmers and their diverse agricultural systems, and because PPB allows selection for the specific adaptation required for such a diversity of target environments. Today, about 80 participatory breeding programmes are known worldwide, involving various institutions and various crops. In 2000, an international review of plant

breeding research methodologies concluded that PPB should be an "organic" part of every plant breeding programme aimed at benefiting small-scale farmers in difficult, high-risk environments. In fact, traditional farming and low-input systems, including organic agriculture, are a very heterogeneous population of target environments and not easily served by centralized, conventional plant breeding.

The book demonstrates that PPB is in essence no different from conventional plant breeding, being based on the very same principles of Mendelian, quantitative and population genetics, and therefore has complemented the traditional approach to plant breeding with a number of chapters addressing issues specifically related to the participation of farmers in a plant breeding programme.

The authors of the various chapters have been carefully selected to represent three groups of scientists: the first comprises internationally recognized experts in genetics as related to plant breeding, and in the various aspects of plant breeding (from general methodological issues to more specific issues, such as breeding for resistance to biotic and abiotic stresses, high yield potential, molecular breeding and genotype × environment interactions); the second group is represented by professional breeders who have actually practised participatory plant breeding with a number of different crops and in a number of socially and climatically different areas, using the range of methods presented by the first group; and, finally, the third is represented by a group of scientists with specific expertise in areas not usually covered in classical plant breeding books, such as variety release mechanisms, seed diffusion, institutional issues associated with PPB, and intellectual property rights. A chapter documenting the impact that participatory plant breeding has had after about thirty years of practice has been chosen to be the logical conclusion of the book.

The book is aimed at plant breeders, social scientists, students and practitioners, with the hope that they all will find a common ground to discuss ways in which plant breeding can be beneficial to all and can contribute to alleviate poverty.

Finally, we would like to acknowledge everyone who has, directly or indirectly, contributed to the book: the CGIAR Participatory Research and Gender Analysis Program (PRGA) for the initial idea of producing such a book, the contributors of the chapters for sharing their scientific experience and for enduring a number of revisions of their respective chapters, Dr P.G. Rajendran for his help in the initial editorial efforts and the Directors-General of our Institutions for their continuous support. Final editing and preparation for publication was done by Mr Thorgeir Lawrence.

Abbreviations and acronyms

AB-QTL	Advanced Backcross QTL Analysis
AFLP	Amplified fragment length polymorphism
AMMI	Additive main effects and multiplicative interaction
AMOVA	Analysis of molecular variance
ANOVA	Analysis of variance
AOSCA	Association of Official Seed Certifying Agencies
ABS	Accelerated Breeding System [for sweet potato]
ASSINSEL	International Association of Plant Breeders for the Protection of Plant Varieties
AVP	Asexually or vegetatively propagated
BC_n	Back-cross generation *n*
BLUE	Best Linear Unbiased Estimate
BLUP	Best Linear Unbiased Prediction
BPE	Before present era
BSA	Bulked Segregant Analysis
Bt	*Bacillus thuringiensis* [gene]
BYDV	Barley Yellow Dwarf Virus
CBD	Convention on Biological Diversity
CBP	Centralized breeding programmes
CCN	Cereal cyst nematode
CE	Common era
CGIAR	Consultative Group for International Agricultural Research
CIDA	Canadian International Development Agency
CIE	Commission Internationale l'Eclairage
CIAL	Local agricultural research committees [in Latin America]
CIAT	International Center for Tropical Agriculture
CIMMYT	International Wheat and Maize Improvement Center
CIP	International Potato Center
CPB	Conventional plant breeding
cv	Cultivar [= cultivated variety]
DArT	Diversity Arrays Technology
DBP	Decentralized breeding programmes
dES	Diethyl sulphate [a mutagen]
DF	Degrees of freedom
DH	Doubled haploid
DHPLC	Denaturating high performance liquid chromatography
DM	Dry matter

DPBP	Decentralized-participatory breeding programmes
DUS	Distinctness, Uniformity, Stability
DW	Dry weight
ELISA	Enzyme-linked immunosorbent assay
EMS	Ethane methyl sulphonate [a mutagen]
EPA	Environmental Protection Agency [United States of America]
F_n	Filial generation *n*
FAO	Food and Agriculture Organization of the United Nations
FDA	Food and Drug Administration [United States of America]
FFS	Farmer field school
FIPAH	La Fundación para La Investigación Participativa con Agricultores de Honduras
FK	Farmer knowledge
FPB	Formal plant breeding
FR	Farmers' Rights
FV	farmer variety [± locally selected]
G×E	Genotype × Environment (Interaction)
GGE	Genotype main effect (G) plus Genotype × Environment (GE) Interaction
GIS	Geographical Information System
GMO	Genetically modified organism
GURT	Genetic Use Restriction Technology
G×L	Genotype × Location
G×Y	Genotype × Year
HPLC	High performance liquid chromatography
IAEA	International Atomic Energy Agency
IARC	International Agricultural Research Center
ICARDA	International Center for Agricultural Research in the Dry Areas
ICP	Inductively coupled plasma [mass spectrometry]
ICPOES	Inductively Coupled Plasma Optical Emission Spectrometer
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ID	Inbreeding depression
IDRC	International Development Research Centre [Canada]
IFPRI	International Food Policy Research Institute
IITA	International Institute of Tropical Agriculture
INCA	National Institute for Agricultural Science [Cuba]
IP	Intellectual property
IPGRI	International Plant Genetic Resources Institute [now Bioversity International]
IPM	Integrated pest management
IPR	Intellectual Property Rights
IRRI	International Rice Research Institute
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
LD	Linkage disequilibrium

LD_{50}	Lethal dose killing 50% of target
LD_{100}	Lethal dose killing 100% of target
MAS	Marker-assisted selection
MCA	Multiple correspondence analysis
MET	Multi-environment Trials
MFN	Most favoured nation
MNU	Methylnitrosourea [a mutagen]
MRRS	Modified reciprocal recurrent selection
MS	Mean square
MTA	Material Transfer Agreement
MV	Modern variety
MVD	[FAO/IAEA] Mutant Varieties Database
NARS	National agricultural research system
NDVI	Normalized Difference Vegetation Index
NERICA	New Rice for Africa
NIL	Near-isogenic line
NIRS	Near Infrared Spectroscopy
NIR	Near-infrared [spectrum]
OECD	Organisation for Economic Co-operation and Development
OFSP	Orange-fleshed sweet potato
OPC	Open-pollinated cultivar
PBK	Plant breeder knowledge
PBR	Plant breeder's rights
PC	Principal components
PCR	Polymerase chain reaction
PGR	Plant genetic resources
PPB	Participatory plant breeding
PRA	Participatory rural appraisal
PRGA	[CGIAR] Participatory Research and Gender Analysis [Program]
PRI	Photochemical reflectance index
PSD	Participatory seed dissemination
PVP	Plant Variety Protection
PVS	Participatory varietal selection
PVX	Potato virus X
PVY	Potato virus Y
QTL	Quantitative trait locus
R&D	Research and development
RAPD	Random amplified polymorphic DNA
RCB	Randomized complete block [experiment design]
REML	Restricted Maximum Likelihood
RFLP	Restriction fragment length polymorphism
RFSRS	Reciprocal full-sib recurrent selection
RIL	Recombinant inbred line

RRS	Reciprocal recurrent selection
S_n	Selfed generation *n*
SD	Standard deviation
SE	Selection environment
SE	Standard error
SFNB	Spot form of Net blotch
SMTA	Standard Material Transfer Agreement
SNP	Single nucleotide polymorphism
SPCSV	Sweet potato chlorotic stunt virus
SPFMV	Sweet potato feathery mottle virus
SPVD	Sweet potato virus disease
SR	Simple Ratio Vegetation Index
SS	Sum of squares
SSR	Simple sequence repeat
SSTW	Small-scale Third World
TGV	Transgenic crop variety
TILLING	Targeting Induced Local Lesions In Genomes
TLC	Thin-layer chromatography
TPE	Target population of environment
TPS	True potato seed
TRIPs	[Agreement on] Trade-Related Aspects of Intellectual Property Rights
UPOV	International Union for the Protection of New Varieties of Plants
USDA	United States Department of Agriculture
UV	Ultraviolet [radiation]
VCU	Value for Cultivation and Use
VIS	Visible spectrum
WARDA	Africa Rice Centre [formerly the West Africa Rice Development Association]
WI	Water index
WIPO	World Intellectual Property Organization
WTO	World Trade Organization
WUE	Water-use efficiency

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