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Dedication: Rodomiro Ortiz Plant Breeder, Catalyst for Agricultural Development

Jonathan H. Crouch
Agrinovis Ltd.
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I. PREAMBLE

Rodomiro Ortiz stands in a field of plantains in the Niger delta surrounded by a small group of young Nigerian technicians and the air is charged with excitement. His face drips with sweat in the heavy humidity and his legs are spread wide to ensure nothing unsettles his decisiveness. This is selection time, Ortiz-style!

He is armed with a clipboard, pencil, and the all important short ruler while Josephine Okoro and Boniface Dumpe each shout out their designated data classes in rapid succession. And to one side, Mark Yamah waits to deliver the single swing of his machete that would mark the end of yet another genotype based on just one word from the boss: "cut"! And woe betide any one who gave the wrong data or if Mark misheard that heavy Spanglish pronunciation of the alternative command: "keep"! For there was no turning back once the machete was in flight, just a split second pause while gravity took hold and the 10 ft tall giant crashed to the ground. Not pausing for breath, they move straight on to the next, for they have at least another 200 genotypes to get through that day. Ortiz would drive his team through that field with the precision and timing of a military operation: at the end of it all, you could be forgiven for thinking that a hurricane had passed through. For breeding is a numbers game and Rodomiro was not about to compromise his experimental designs just because of the size of the plantain crop.

These were the early days of the Ortiz era in the Plantain and Banana Improvement Program (PBIP) of the International Institute of Tropical Agriculture (IITA) at Onne Station, southeast Nigeria. From this scene, anyone would have thought Rodomiro had been doing this all his life, but in fact this was the first season he had done selections on his own. And like so many of his reincarnations to come, he had hit the ground running, and the seismic waves of change were not far behind. I too was in that crowd alongside Josphine and Boniface, a fresh postdoc just landed in Africa looking for the impossible: a rigorous scientific environment, meaningful impacts for the poor, and a bit of adventure. For my luck, Rodomiro was dispensing it all by the truckload, and from the very first moment we met I was in awe of this intellectual giant and his swashbuckling taming of *Musa* breeding and genetics. Southeast Nigeria was a tough posting by anyone's standards but for me this baptism by fire into the world of international agriculture and tropical crop breeding could not have been more exhilarating. And Rodomiro's relentless night and day toil in that humid rain forest would soon bring him global recognition through his role in the team winning the King Baudouin Award in 1994 and through reaching the finals of the Prince Asturias Award in 1997 for his personal achievements.

So how did a Peruvian son of a civil servant, brother of two lawyers and an accountant find himself in a field of plantains in Nigeria? The story of how he got there is almost as incredible as the man himself, only surpassed by the career he carved for himself over the following two decades. Rodomiro was fascinated by mathematics, logic, and perfection from a very early age but drawn to the field of biology as a teenager and from there into genetics, statistics, and plant breeding. Driven to fight for his political ideology at university in ways few of us can imagine yet then motivated to spend the rest of his life trying to help resource-poor small-scale farmers across the developing world, especially in Africa. What Rodomiro has achieved in the last 20 years since finishing his Ph.D., few of us dare dream of achieving in our entire lifetime. And thus, it is fitting that he should receive the accolade of a dedicatory chapter at a time when we fully expect to see at least another 20 years of reaching ever new heights of achievement.

Rodomiro Ortiz is well known by so many across such a broad range of research topics, that his area of expertise almost defies definition. He has been involved in basic, strategic and applied research in 27 species although a large proportion of his publications have been associated with his primary passion for genetics, genetic resources, and crop improvement. Rodomiro has worked on cereals (maize, barley, wheat, sorghum, pearl millet), legumes (chickpea, groundnut, cowpea, soybean, pigeonpea, white lupin), Solanaceae (*Capsicum* pepper, potato, tomato), clonal crops (sweetpotato, cassava, yam, plantain, banana), fruits (blueberry, cranberry, lingonberry, sweet cherry), as well as *Brassica*, Napier grass, annatto, and quinoa.

Rodomiro's major research achievements range from the definition of core collections of genetic resources for eight different crop species, elucidating the genetic basis of more than 20 agronomic traits in *Musa*, determining meiotic behavior during interploidy crosses in three different genera, and, introgression of pest and disease resistance from wild species to cultivated germplasm in two different crop groups. In addition, he has developed biometrical models to dissect quantitative trait variation in polyploid species and evaluated the gene action underlying economically important traits in order to develop new techniques to improve breeding efficiency. Finally, he has formulated evolutionary crop breeding approaches using landraces and wild species for the genetic betterment of cultivated gene pools of *Musa* and tuber-bearing *Solanum*. These research activities have led to over 250 journal papers, including over 100 as first author and nearly 30 in *Theoretical and Applied Genetics*. In addition, he has authored over 100 book chapters, monographs and policy briefs, over 200 conference

proceedings papers and abstracts, and over 150 newsletter and technical articles (including manuals and bulletins).

Rodomiro's breeding efforts have concentrated on the utilization of wild species and landraces for the development of elite progenitors and cultivars adapted to the environmental conditions in which they would be grown. This included selection for quality traits, disease and pest resistance, and efficient mineral nutrient uptake in addition to yield parameters. He has employed conventional, modified, and novel techniques for germplasm enhancement. Throughout the last decade he has pursued an active interest in the application of molecular biology and genetic transformation in crop improvement. This has led him to author many reviews on modern plant breeding techniques and to appear in many newspaper, radio, and television reports and interviews on the subject. He has become especially renowned for his simple and unbiased perspectives on the pros and cons of genetically modified (GM) food.

Alongside his research and breeding activities, he has held a range of senior management positions where he directed a diverse range of research programs focused on sexually and vegetatively propagated crops, in annual and perennial production systems including many of the most important food crops of the developing world: wheat, maize, sorghum, millet, cassava, yams, plantains, bananas, cowpea, soybean, chickpea, groundnut, and pigeonpea. This has led him to visit no less than 90 countries, managing projects in a large proportion, while developing strong collaborators and loyal friends in many. More recently he has also become a leading voice in systems-based agricultural research, particularly related to climate change and biofuels.

This deep and extensive firsthand experience of research and breeding across the developing world combined with his rigorous scientific process and dedication to institutional improvement, together with his huge global professional network has led to him being widely considered as one of the most important thought leaders and catalysts in international agricultural development for resource-poor small-scale farmers.

II. EARLY YEARS

A. Formative Experiences

Rodomiro Octavio Ortiz Ríos was born on 28 July 1958 in Lima, Peru, the first son of Juan Rodomiro Ortiz Bernardini and Otilia Soledad Ríos Higginson. Rodomiro grew up alongside two older sisters and a younger brother, all overachievers. San Antonio de Padua, a private Canadian primary school in Lima run by nuns and priests, was to put Rodomiro on

a critically important path. He became fluent in English and was quickly attracted to mathematics. Rodomiro recalls "I enjoyed math at school because it was so logical, there was no way of making a mistake if you followed the right procedure." The same sense of logic, precision, process, and order was also the appeal when he later discovered the field of genetics, and was to become a fundamental part of the Ortiz brand throughout his research and management careers.

At the age of 11, Rodomiro moved to "San Andres" secondary school established in Lima under the auspices of the Free Church of Scotland. The school had a partnership with a Scottish textile company that had expanded its operation into Peru. The school was founded by a Scottish missionary, John Mackay, with a reputation for almost military discipline but also for promoting the principles of democracy that appealed to his father. In addition, this was a school that produced leaders, former pupils going on to become famous intellectuals, scientists, artists, and investment bankers but also high-level ranking officers of the armed forces and even the 84th President of Peru.

A discussion of Rodomiro's formative years would not be complete without tracing the origin of his tendency to write using a small ruler. His mother recounts that Rodomiro's fixation with tidiness started when he was very young. This is clearly the origin of his infamous clean-desk policy but the straight writing habit had an additional driver. It stems from his desire to be the best student at junior school and his decision to adopt the approaches of the leading contenders. This epitomizes Rodomiro's approach to life; constantly on the lookout for ideas and new approaches for improvement of his own performance, which he would subsequently apply to helping those around him.

Mathematics and the competitive spirit were dominant themes in the Ortiz household. By the time he had started secondary school, his father was practicing math with him from 5 o'clock in the morning. Young Rodomiro also became interested in researching topics to feed his inquisitiveness through reading, often into the early hours. Thus, a pattern of late night and early morning studying was to emerge as a defining way of life.

On Easter Sunday 1971 shortly before his 13th birthday, Rodomiro made an unexpected yet emphatic decision that was to have a significant impact on his next decade. On the way to church that day, he had what he describes as his "religious crisis" and announced to his strongly Catholic family that he was going to stop attending church from that day. Rodomiro recounts that the next day his father took him aside and said "If you have decided not to follow any religion, then its important that you read the teachings of other great schools of thought." And from

that point began to feed him books from the great thinkers of philosophy, psychology, and politics, from Plato to Marx and Engels, and Freud to Gramsci. Much of this was highly topical in Peru at this time as the country was undergoing dramatic political changes throughout Rodomiro's teenage years. The coup of the late 1960s had delivered a military dictatorship with left-leaning policies that were leading to substantial changes across the country including nationalizing companies, driving land reform and giving rights to the workers. And thus was born Rodomiro's fascination with history and current affairs, something that would lead him into profound experiences during his university years and ultimately drive him to move to Africa.

Although Rodomiro's parents put no pressure on him regarding his choice of career, nevertheless, he seemed preoccupied during his early teenage years with what he was going to do with his life. However, once he had made the decision in his late teens to pursue a career in biology, his mother noticed that he became dramatically more committed to studying. Sadly at the end of his school years, his father had a major heart attack and Rodomiro spent many hours with him daily while he was recovering in hospital. His mother recalls from this time that Rodomiro always had two things with him in the hospital; a biology textbook (studying for the university entrance exam) and a football (soccer) magazine.

B. University in Peru

In April 1975, Rodomiro joined the Universidad Nacional Agraria at La Molina (UNALM) in Lima to study biology having recorded the second highest entrance exam mark from over 200 candidates. This feat is all the more impressive given that Rodomiro refused to attend special classes to prepare for the university entrance exam, preferring to do it his own way. This strong self-confidence in his ability to work things out himself has never deserted him since.

Two individuals had a particularly important role in his decision to specialize in genetics at university. First, Prof. Francisco Delgado de la Flor, an agronomist by training who had become the chancellor of another university in his early thirties and later returned to UNALM in the 1970s as Professor of Genetics and Horticulture and Head of the Vegetable Research Program (he was also twice elected in the 1990s as Chancellor of the university). Second, Prof. Emma Loza, Rodomiro's undergraduate advisor and cytogenetics lecturer, who had taken the cytogenetics course with Prof. Peloquin at the University of Wisconsin (UW), where Rodomiro would ultimately carry out his own Ph.D. research.

Throughout most of his undergraduate years, Rodomiro was President of the Centro de Desarrollo Social (CEDES) and a member of the Peruvian Local Committee of the World University Service (WUS, SUM), which were both nongovernment organizations (NGOs) mobilizing students to do social work. During this time, Rodomiro was also a member of the Coordinating Committee for International Voluntary Service (CCSVI) associated at that time with the United Nations Education, Science and Culture Organization (UNESCO). His role as CEDES president gave him his first international trip in November 1980, traveling to India for a youth congress of voluntary organizations and the annual meeting of CEDES umbrella organization. During this trip, Rodomiro also took the opportunity to stop in Paris to visit other NGOs and UNESCO headquarters. These activities gave him an important early insight into the international community, that he would soon become part of himself.

During his transition year between undergraduate and postgraduate studies, Rodomiro experimented as a journalist for the magazine *Hermano Lobo* publishing from Lima with unconventional perspectives on politics, society, and the arts. His love of reading was evolving into a passion for writing, an outlet that would become an incredibly important component of his life.

During the late 1970s there was a growing resentment in Peru against the 10-year rein of the so-called "Revolutionary Government of the Armed Forces." The university campuses, which were outside the jurisdiction of the police, became a breeding ground for prodemocracy activists. At this time, Rodomiro was becoming heavily involved in students' affairs through his elected role as organizational manager of the UNALM Student Association (FEUA). And he joined the student's opposition to the military government, campaigning alongside many fellow students for the return to democracy. When the dictatorship changed and started implementing right-leaning policies, the opposition movement gained pace and their demonstrations shifted to the streets often resulting in violent clashes between students and police. Although his parents respected Rodomiro's wish to express his political ideals, they were concerned for his safety as the shootings, kidnappings, interrogations, and jailing's of students increased. Fortunately, constitutional elections were carried in 1980 and a newly elected government came into power on an auspicious day; Rodomiro's 22nd birthday. However, amidst the euphoria of the transition to democracy and the politicking during the creation of the new government, Rodomiro made an astute differentiation regarding his own personal motivations: political ideals versus political power.

Rodomiro's continued interactions with Prof. Delgado de la Flor had opened his eyes to the opportunities in agriculture and led him to carry out his B.Sc. research project on chilli peppers and from there his M.Sc. research in plant breeding and statistics. And it was discussions with Prof. Delgado de la Flor that finally convinced Rodomiro to move away from politics and focus on a career in agricultural research. Although Delgado himself would subsequently pursue his own political aspirations; initially being elected to the National Magistrate Council, of which he later became the president, and then unsuccessfully running for congressman of Lima.

During 1984–1985, Rodomiro carried out his M.Sc. research under the supervision of Prof. Ricardo Sevilla. His thesis focused on the classification of maize landraces from the highlands of Peru, one of the world's greatest centers of diversity for maize. The purpose of the work was to devise a system that would enable more effective use of this germplasm in maize breeding. However, this was far from what Rodomiro had originally planned when he first registered for his M.Sc. with Prof. Delgado de la Flor. He was initially pursuing research on mutation breeding of *Capsicum baccatum* (a chilli pepper species indigenous to Peru). Unfortunately, his field trial was affected by drought and did not provide useful data. Thus, Rodomiro was hunting for an alternative data set to analyze for his thesis. Luckily, Prof. Sevilla had a huge amount of field data from his maize germplasm characterization trials, which he shared with Rodomiro to analyze. Prof. Sevilla recounts: "I never did a better deal in my life" as Rodomiro set about subjecting the data set to what we now consider as his usual exhaustive and elegant analysis. However, that was just the beginning, as he continued to write up the journal papers from this analysis during his spare time while subsequently working at CIP, University of Wisconsin, IITA and beyond—the latest one published in 2008. At each stop in his global professional tour, he would come across further mega-data sets waiting for attention. And thus continued the trend of ever accumulating rounds of analysis and publication.

Despite the shift of supervisor for this M.Sc. thesis research, Rodomiro continued to be mentored by Prof. Delgado de la Flor, who encouraged him to follow many courses in agronomy despite his specialization in breeding and statistics. This was a very prudent move that maintained his broad-based perspectives, which proved invaluable both for his later research activities in the Consultative Group on International Agricultural Research (CGIAR) but also when Rodomiro subsequently became a research manager across diverse crop science disciplines. His ability to effortlessly shift across disciplines

and to automatically zoom in and out on specific topics continues to be one of his great strengths in research and management.

Incredibly, even at this earliest stage of his research training, Rodomiro was able to turn an M.Sc. taught course into a publication opportunity. Prof. Marco Nevado at UNALM was teaching the graduate course in genetic analysis. Interactions with Rodomiro during this course led to a statistical analysis paper (Nevado and Ortiz 1985) that would form the foundation of the analysis for his M.Sc. thesis research (Ortiz and Sevilla 1997) and a subsequent collaboration with the Food and Agriculture Organization (FAO) (Ortiz and Izquierdo 1992). A remarkable achievement for an M.Sc. student but for Rodomiro just a small indication of what was to come.

While following his M.Sc. studies, Rodomiro managed to secure a place on the mutation breeding course run by International Atomic Energy Agency (IAEA)/Food and Agriculture Organization at their laboratory in Seisberdorf outside Vienna in Austria (March–May 1984). During the evenings he busied himself with homework from the course so as to free-up his weekends for trips to neighboring countries to the east through the "Iron Curtain"; Budapest (Hungary), Prague (in today's Czech Republic), the former Yugoslavia, and Croatia as well as to various cities in Austria. On the way back from the course Rodomiro also visited Madrid and the Toledo province of Spain. This was to be the beginning of his great journey in international agricultural research that would ultimately take him to nearly a hundred countries and the senior management teams of international agricultural research centers on three continents.

After completing his M.Sc., Rodomiro briefly worked as an assistant plant breeder in the cereals program at UNALM. However, the pull of bigger challenges was too strong to resist for long and Rodomiro was soon planning his departure from the university to join the International Potato Center (CIP). Upon hearing this, Professor Delgado de la Flor took him to Professor Alberto Fujimori, who was the Chancellor of UNALM at this time, in an attempt to change his mind. Fujimori had lectured Rodomiro in mathematics during his first year at the university. Rodomiro recalls that Fujimori remembered him, reflecting on his 100% score in one of his final mathematics exams. However, Rodomiro's mind was made up and not even Fujimori's attention was going to change that. By 1990, Fujimori was elected President of Peru and Rodomiro was in the United States finishing his Ph.D. research. It is incredible to think of the role that this agricultural university played in the emerging national politics of Peru at this time. That Rodomiro was intensely involved in this political evolution enabled him to develop a strong

leadership style that would be invaluable just a few years later when he made the transition from a young researcher in the United States to a program leader at the IITA in Africa in the early 1990s.

Most recently, Rodomiro has gone full circle while being back in Lima (especially during 2010–2011), picking up on old collaborations at UNALM and representing the "biotechnology—plant breeding—genetic resources" debate in university seminars, newspaper articles, and television interviews. Prof. Sevilla reflects: "Everybody recognizes Rodomiro's great capacity and brilliance in this area, he has become a national opinion leader during these traumatic times for the biodiversity community"—a great legacy in itself but meanwhile a much greater legacy was to be created when he turned his attention to international agricultural research for development.

III. RESEARCH CAREER

A. Potato Research at the International Potato Center (CIP)

Although Rodomiro's outstanding capabilities were already well recognized during his time at UNALM, his move to the CIP was to unleash a tidal wave of publications that no one, not even Rodomiro himself, could have predicted. From the data he generated during the 4 years (1984–1988) that he worked at CIP as an associate geneticist in the Breeding and Genetics Department, he would eventually publish 27 journal papers, 13 of those as first author. Incredibly, the last of these papers would not appear in print until nearly two decades later by which time Rodomiro had already moved job and country six times. This never ending squeezing of new research findings (and related publications) from old data sets was to become the hallmark of Rodomiro's career.

Rodomiro's first paper from his potato research at CIP reported analysis of morphological variation in heat tolerant and susceptible germplasm grown under a range of glasshouse and field conditions (Morpurgo and Ortiz 1988). The paper concluded that controlled environment screening was not a good surrogate for selection of heat tolerant germplasm for field production. And thus began Rodomiro's lifelong dedication to carrying out rigorous science for practical outcomes, particular for crop improvement.

The same year, Rodomiro published his first journal paper as lead author and his first paper on a topic that would become a lifelong theme in his research career across a number of crops: ploidy manipulation. The paper was based on evaluation of germplasm generated from

a line × tester crossing program using 2*n* gametes from a range of male parents crossed with a range of female parent tester lines (Ortiz et al. 1988). This report epitomized the large-scale data collection combined with intensive and elegant statistical analysis, which has become the trademark of the massive body of publications he has subsequently generated over the following quarter of a century. The paper concludes that for a range of agronomic traits, the direction of the cross was highly important when using ploidy manipulation in potato breeding. This is due to the relatively stronger influence of the 2*x* parent in progeny from such crosses. The paper also confirmed that progeny testing was essential for selection of parental genotypes for such a breeding scheme. This work launched what was to become a lifelong professional partnership and friendship with Dr. Masa Iwanaga (now President of the Japan International Research Center for Agricultural Sciences (JIRCAS)), which was to endure across three continents and seven research organizations.

Dr. Iwanaga was cytogeneticist at CIP at the time and was just about to make a career progression move to the IITA, when a counteroffer from Dr. Richard "Dick" Sawyer (the then Director General of CIP) managed to keep him at this international center. Part of that deal was the provision of funding to hire his first research associate. It was the recruitment process for that position that then enticed Rodomiro to leave UNALM. In particular, it was Masa's research on ploidy manipulation with haploids, 2*n* gametes and wild species for potato and sweetpotato germplasm enhancement that captured his attention. Dr. Iwanaga recalls that during his time at CIP, Rodomiro surprised him many times by arriving at his office early in the morning with the full statistical analysis of results that had only just been collected through a long hard day of harvesting in the field the previous day. It was clear from this earliest of times that Rodomiro's inquisitiveness could not allow him to sleep before finding out what a new data set could tell him.

During his early days at CIP, Rodomiro also established a particularly productive friendship with Dr. Ali Golmirzaie who was a new postdoc. Despite working in completely different research groups, Rodomiro happily helped Ali with experimental design and analysis while he was at CIP, and continued to collaborate remotely for many years thereafter. This epitomizes Rodomiro's interaction with every scientific community he has passed through. His personal interest drives him to want to understand the work of everyone around him, and those doing interesting research with an open-minded approach can expect that it will not be long before Rodomiro engages them in a challenging dialogue about their work. Where intellectual synergy prevails, he will freely

share his conclusions and recommendations without reticence, and if you really catch his interest he may offer to work his analytical magic on your data. Ali and Rodomiro would go on to publish 14 papers together over the following 15 years during which time Rodomiro would have moved job and country seven times.

Soon after joining CIP, Rodomiro was involved in work that would lead to a major publication on the successful transfer of nematode resistance from diploid wild tuber-bearing *Solanum* species to cultivated tetraploid potatoes (Iwanaga et al. 1989). This paper included the demonstration that the direction of the cross (and thus the diploid species cytoplasmic genome) was not important for this trait. The transfer of sources of resistance from wild relatives was a tremendous step forward for potato breeders at the time and a practical success that influenced a large number of Rodomiro's breeding schemes across several diverse crops through the following two decades.

By the time the nematode resistance paper was published, Rodomiro had left CIP and started his Ph.D. research at the University of Wisconsin with Professor Stanley J. Peloquin. A shift that was to see an exponential increase in his rate of publication, not least for papers from his work at CIP, and the beginnings of his tremendous assent in the crop genetics and breeding literature. Most of the papers based on data he had been involved in generating at CIP were written after he had left Peru. Some during the time he was in Wisconsin, but most spread over the following decade while he was in Nigeria, Denmark, and beyond. Thus began a lifelong habit of returning to old data sets with a fresh mind to create new insights, which of course, he would share with the world through new journal papers. This reflects his incredible determination to take everything he starts through to completion and to constantly re-evaluate his own ideas as new findings appear in the literature or are shared with him. This way of working is highly dependent on his encyclopedic memory and meticulously organized archive. For example, it would not be unusual for him to be reading a new research finding or engaging in an e-mail dialogue that would trigger a new question about an old unutilized data set (generated perhaps a decade earlier), which he would then instantly find in his archive, and more often than not, analyze that evening and generate a first draft of the resultant manuscript over the following weekend. For the mere mortals around him, this has been an aware-inspiring process to experience firsthand, that he has routinely repeated countless times where ever he has worked.

Between 1990 and 2004, Rodomiro was involved in 24 journal publications based on his 4 years research activities at CIP (1984–1988). These

papers covered a wide range of areas including the inheritance and breeding of resistance to potato tuber moth (Ortiz et al. 1990b) and early blight (Ortiz et al. 1993d), the development of diverse genetic stocks with high levels of pest resistance (Watanabe et al. 1994), the transfer of nematode resistance from wild species using ploidy manipulation (Ortiz et al. 1997c), and, the effect of inbreeding on the use of true potato seed from Andean landraces (Golmirzaie et al. 1998a) and heterogeneous hybrid populations (Golmirzaie et al. 1998b). His work at CIP also resulted in several papers published in Spanish on true potato seed (Golmirzaie et al. 1990a,b) as well as on the genetics of 2*n* pollen production (Camadro et al. 1993) and ploidy manipulation in potato breeding (Ortiz et al. 1993b).

B. Potato Research at the University of Wisconsin-Madison

At the end of July 1988 on the eve of his 30th birthday Rodomiro left his job at CIP and his family in Lima and moved to the University of Wisconsin at Madison on the edge of Lake Mendota. Founded in the late 1840s, the University of Wisconsin has grown to become one of the top 10 public universities in the United States with an annual research budget of over 1 billion dollars (second only in the United States to John Hopkins University). This scale-up of his environment seems to have turbo charged Rodomiro's productivity. The inspirational mentoring from his supervisor, Campbell-Bascom Professor Stanley J. Peloquin, was surely a significant part of this. When Rodomiro joined him, Prof. Peloquin had already been elected a few years earlier to the National Academy of Science for his contributions to understanding mechanisms of chromosome manipulation and behavior. They would eventually write 20 journal papers from their 3 years of research together (1988–1991), although Rodomiro was also busy during this time writing papers from his potato research at CIP and from his research at UNALM on hot *Capsicum* pepper.

Incredibly, Rodomiro also took on a data analysis consultancy project during his first months at Wisconsin, working on regional tomato trial data for the FAO of the United Nation. Juan Izquierdo had been a fellow student with Rodomiro during the annual IAEA training course on mutation breeding in Vienna/Seiberdorf (Austria) from March to May 1984. Juan witnessed how Rodomiro challenged some of the lecturers on that training course, especially those in genetics, cytogenetics and biometrics classes, and thought they might make good research partners. A few years later when Juan was working for FAO's Technical Cooperation Network on Plant Biotechnology for Latin America and the

Caribbean, he finally had the opportunity to collaborate with Rodomiro. This is so indicative of the impact that Rodomiro has on so many people, that has led to an ever-increasing line of scientists waiting to have the opportunity to build a research partnership with him. And as in so many other cases, this collaboration continued for decades. Rodomiro had already published on analysis of variances across environments in tomato before meeting Juan, and this paper had described exactly the type of analysis that Juan needed for his current data (Nevado and Ortiz 1985). And thus Rodomiro was contracted during his first months at UW to carry out the necessary analysis of GE interactions, stability analysis, and correlations between environment, traits and tomato yields, although he would not write the paper until he had moved to IITA in Nigeria (Ortiz and Izquierdo 1992). Rodomiro would subsequently write two more papers from this data set; one comparing performance of clusters of locations (ranging from high-to-low yielding environments) and determining where selection for yield could be most effective (Ortiz and Izquierdo 1994); and the other, many years later when he was at CIMMYT in Mexico, following discussions with the head of the biometrics unit, Dr. José "Pancho" Crossa, on models for analyzing GE data (Ortiz et al. 2007a). Rodomiro constantly amazes his colleagues with the effortless way that he connects new research findings with long since buried data sets, in ways that not only extract new perspectives but usually also new papers.

Rodomiro credits his dramatic increase in publication rate while at UW to the academically competitive environment and mentoring from Stan Peloquin who always encouraged his students to publish their research results as he considered that the job was not done until the paper was published. A tenet that Rodomiro still holds strongly to this day, although something that seems to have come naturally to him without too much encouragement. In fact, there was also a strong internal driver based on Rodomiro's wish to share what he had learned and improve the overall efficiency of the research system, as he explains "I have always felt frustrated that some scientists were repeating experiments that others had carried out previously because the original work had not been published."

A fellow student from Peru, Félix Serquén (now a tomato breeder at Syngenta, USA), who overlapped with Rodomiro through the same path from UNALM to CIP to UW, reflects "He was passionate about plant breeding, genetics and biometrics, which he combined with a great capacity for writing—he had the ability to analyze any data and convert them into publications." Domenico Carputo who joined Peloquin's group after Rodomiro had left Wisconsin, recalls that "Prof. Peloquin

often mentioned the great capacity of Rodomiro to efficiently and quickly write papers. He told students that the day after planning a manuscript, Rodomiro had the paper ready." Although this was not the only thing he was renowned for at that time. Fellow UW student Mario Mera Krieger (now a bean breeder at Instituto Nacional de Innovación Agraria (INIA) in Chile) remembers that Rodomiro was such an affable and loquacious person, they became friends within a matter of minutes of meeting each other. Mario recounts "Rodo was known for turning nights into days chatting with friends, usually in front of rather unhealthy beverages, and remarkably, the day after he was as fresh as a lettuce." Anyone who has been fortunate enough to enjoy a similar long evening with Rodomiro will vouch that the same is still true to this day.

Prof. Stan Peloquin would ultimately supervise 98 graduate students from 34 countries, many of them going on to build great careers in national or international research systems. Stan gained tremendous satisfaction from the successes of all his students but he had a special place in his heart for Rodomiro, as Mario Mera Krieger recalls "Every time Prof. Peloquin mentioned Rodo his throaty voice became even more hoarse, and you could feel the admiration he had for his disciple." They also had something very important in common: a dedication to hard work, as Prof. Peloquin was renowned for saying "hard work always pays off." Rodomiro's first journal paper with Prof. Peloquin resulted from a three-way collaboration including Masa Iwanaga who had been a Ph.D. student with Peloquin some years earlier, before moving onto CIP and subsequently recruiting Rodomiro into his group. The underlying data had been generated by Masa when he was at UW but had not had time to analyze them for his Ph.D. dissertation. So about a decade later, Peloquin decided that it should be Rodomiro who completed the analysis. What resulted was the first report on a male fertility restorer gene in potato based on large-scale comprehensive genetic analysis (Iwanaga et al. 1991). Rodomiro subsequently went on to publish a further paper from his own research at UW potato farm Rhinelander describing male sterility and 2*n* pollen in 4*x* progeny from interploidy crosses (Ortiz et al. 1993c). Thus, it seems that Prof. Peloquin shared the same quality as Rodomiro, in never forgetting a data set.

During the 4 years after completing his Ph.D., Rodomiro published a further 15 journal papers with Prof. Peloquin covering an incredibly wide range of topics including true potato seed (Ortiz and Peloquin 1991a), 2*n* egg production (Ortiz and Peloquin 1991b), genetic analysis using haploids (Kotch et al. 1992), recurrent selection (Ortiz and Peloquin 1992a), population improvement (Ortiz and Peloquin 1993a), adaptation to and performance of 4*x*–2*x* and 4*x*–4*x* offspring

to contrasting day length environments (Ortiz et al. 1991a, 1997d), use of isozymes and other genetic markers for analyzing quantitative trait variation in potato (Ortiz and Peloquin 1992b; Ortiz et al. 1993a), genetic analysis of flower color (Ortiz and Peloquin 1993b), pollen fertility in $4x \times 4x$ and $4x \times 2x$ families (Ortiz et al. 1993c), and sporophytic heterozygosity of the male gametophyte in tetraploid potato (Ortiz and Peloquin 1994a). It seems that however advanced or well populated a research area may be, Rodomiro has the capability to enter it and quickly saturate the literature with new findings and perspectives.

During this time, Rodomiro also published the first of many papers in the high impact journal *Theoretical and Applied Genetics*. The first one was from his Ph.D. research and used crosses from CIP where the progeny were tested at locations in Peru and United States. The study compared ploidy manipulation breeding schemes with conventional approaches to potato improvement (Ortiz et al. 1991b). This novel approach took advantage of $2n$ pollen produced by $2x$ genotypes by virtue of parallel spindle formation at anaphase II, which is genetically equivalent to a first division restitution (FDR) mechanism. These $2x$ parental lines were then crossed with $4x$ parental genotypes. In the reported study, using 32 families evaluated over 2 years at four locations, the $4x \times 2x$ breeding scheme was found to be better than the traditional $4x \times 4x$ method since fewer replications and locations were required to evaluate tuber yield. This is probably due to the greater homogeneity of genotypes generated from $4x \times 2x$ crosses.

Never to miss a publication opportunity, during this period Rodomiro also wrote the first of what was to become an extensive range of review papers (Ortiz et al. 1994a). However, this first one originated from the introduction chapter of his Ph.D. dissertation, which in turn was largely derived from Prof. Peloquin's teachings. For many years, Prof. Peloquin had been developing an experimental breeding program based on ploidy manipulations that he ran in parallel with a conventional breeding program, providing superb teaching tools for students. Now Rodomiro was to write-up all his teacher's lessons from these populations, in one place for a global audience while also summarizing how some potato breeders at CIP were using haploids, wild species $2n$ gametes and endosperm balance number for breeding potatoes for developing countries. This was very much Rodomiro's manifesto for what Prof. Peloquin used to call "putting genes into a usable form." The ease with which sets of chromosomes can be manipulated in potato allows potato breeders to routinely use traits from wild species. The only laborious part of the process is that progeny testing must be carried

out in target environments due to the low parent–offspring correlation and high genotype-by-environment interaction (Ortiz and Peloquin 1991b).

Prof. Peloquin has been widely acknowledged for his pioneering work developing genetic and evolutionary knowledge and translating this into applied breeding methods that had tremendous impact on potato breeding globally. But more incredible was the translation and use of these approaches in a range of other crops including cassava, sweet potato, banana, forages, and berry fruits (Ortiz 2003a), and that for several of these crops it was Rodomiro himself that facilitated that translation. This was the first of many occasions where he would take a novel concept from cutting-edge research and enable its practical application in the breeding of a range of tropical crops, with particular emphasis on benefiting small-scale farmers in developing countries. We all know how important momentum is in research progress but Rodomiro constantly shows us the enormous power that stamina can also bring to bear. He uniquely combines both through the balanced application of his motto "impatience is a virtue" with constant and sustained hard work. In this way, he always goes the extra mile to squeeze out the last drop of impact from any given research finding.

C. Vaccinium Research at Rutgers University

After finishing his Ph.D. research and while waiting to defend his dissertation Rodomiro was contacted by Professor Nicholi Vorsa (the Director of the Blueberry and Cranberry Research Center of Rutgers University at Chatsworth) asking if he would be interested to spend some time working on blueberry cytogenetics and evolution. After 3 years away from home, Rodomiro was eager to go back to Peru, particularly as his father had passed away the previous Christmas. However, Prof. Peloquin convinced him to stay in the United States, not least due to Peru being in an almost state of civil war and thus not the place for Rodomiro to develop his career. Rodomiro would ultimately publish seven journal papers from his 6 months working with Prof. Vorsa. The first four over the following couple of years while he was at IITA were based on analysis of 2*n* pollen (and progeny derived from it) using techniques Rodomiro had learnt in potato and would soon also apply in *Musa*. The remaining three emerged over the following decade.

Rodomiro's first papers with Prof. Vorsa described the occurrence and origin of 2*n* pollen in *Vaccinium* (the blueberry genus) (Ortiz et al. 1992a,b). In particular, it was reported that blueberry polyploids would be expected to have increased fitness and flexibility due to the mode of

2*n* pollen formation, which transmits a high percentage of the heterozygosity and a large fraction of the epistasis from the 2*x* parent to the 4*x* offspring. Two subsequent papers detailed the cytology of 2*n* pollen production (Vorsa and Ortiz 1992) and flow cytometry analyses in *Vaccinium* section *Cyanococcus* (Costich et al. 1993). The flow cytometry paper confirmed the conventional polyploidy evolution in *Vaccinium*, and demonstrated that DNA content corresponded to the previously described phylogenetic relationship among *Vaccinium* species. This paper also reported that there was a large variation in DNA content between species but that this was small in comparison to the variation between ploidy levels. Subsequent papers focused on analysis of cranberry translocation lines (Ortiz and Vorsa 1998, 2004) and studies of pollen viability in blueberry species (Ortiz et al. 1999d).

No opportunity for conversation, it seems, cannot be turned by Rodomiro into a potential scientific collaboration and subsequent publications. For example, during his few months at the Blueberry and Cranberry Research Centers at Rutgers University, Rodomiro shared his daily commute from south Jersey to Chatsworth with Dr. Mark Ehlenfeldt, who was working as research geneticist for USDA/ARS in the same station. Mark was a former student of Prof. Bob Hanneman, who had been a student of Prof. Peloquin. Bob had been among the first to publish on 2*n* gametes with Peloquin. Mark's Ph.D. research was on genetic control of endosperm balance number (EBN) and interspecific hybridization in tuber-bearing solanums. This was exactly the type of topic that fascinated Rodomiro, and thus a collaboration was born and developed through those daily car journeys. Their first paper focused on the role of EBN in explaining evolution of the cultivated potato polyploid series (Ortiz and Ehlenfeldt 1992). Endosperm failure is a major mechanism underlying the barrier for hybridization and speciation of sympatric species within the same ploidy level. The paper goes on to describe how knowledge of the EBN process can be used for chromosome engineering or incorporation of wild *Solanum* species germplasm into the cultigen potato pool. Their second paper then took a broader look at the origin and significance of EBN across the angiosperms (Ehlenfeldt and Ortiz 1995), describing its polygenetic basis for regulating both interspecific and intraspecific crosses and concluding that the system appears to have originated to ensure diploid fidelity. These were hugely challenging topics, both in depth and breadth, for such young scientists to be taking on. But as Rodomiro reflects "Sometimes you don't need to be in the office, lab or field to capture synergy and create good ideas." Certainly, when Rodomiro is involved there are many around the world who would agree with this.

D. *Musa* Research at the International Institute of Tropical Agriculture (IITA)

No sooner had the flow of papers from his potato research begun to gain momentum than the avalanche of papers from his *Musa* research began. In 1992, Rodomiro joined the PBIP of the IITA based at Onne, near Port Harcourt in southeast Nigeria. Onne Station was a small 100 ha plantation in the swamps of the Niger delta, a precarious 10 h drive from IITA headquarters in Ibadan. The delta was famous for its oilrigs and flares, its social uprising and brutal violence. It was not the type of place you would expect to spawn a revolution in crop genetics. But for Rodomiro, Onne Station had a beautiful secret that was to make it his very own El Dorado.

Rodomiro had joined IITA in response to his inquisitiveness about Africa, but what he found in Onne Station was to also satisfy his hunger for data for many years to come. During his first days at Onne Station, he was shown a humble dusty storeroom that would become his nocturnal shrine for the following 5 years. That storeroom contained nothing more exciting than a series of filing cabinets, but the magical thing for Rodomiro was that those filing cabinets were full of data collected from a decade or more of field trials at Onne Station. The data had been used for testing agronomic practices, evaluating genetic resources, and facilitating breeding selections, but not for genetic analysis. A dream come true for Rodomiro, who could start applying his magic without having to wait to generate data—not an insignificant issue for a crop with an 18 month cycle and a 6 m^2 space requirement. Of course Dirk Vuysteke (PBIP leader at that time), who had recruited him, knew this was what his program needed and that's why he was so excited to have found a top rate geneticist. When Dirk had seen Rodomiro's CV during the short-listing process he is reported to have said "If someone could have as many publications as he [Rodomiro] had, prior to obtaining his Ph.D., then the sky is the limit." But even Dirk with all his insight and vision could probably not have imagined the scale and intensity of what was to come.

From the data he found and analyzed plus the data he was subsequently involved in collecting during the 5 years (1992–1996) he worked at Onne Station, Rodomiro would ultimately publish 85 journal papers. A level of publication output that most of us aspire to achieve in our entire career. Moreover, since leaving the CGIAR at the end of 2009, Rodomiro has launched a resurgence of new *Musa* publications, including 5 journal papers and 12 book chapters in 2010, 2011, and accepted for 2012. And we know by now to expect that others are still to follow. This epitomizes the legacy that Rodomiro leaves on every area of research that he touches. Not only is he revered by the new generation

of researchers in that area but he is also constantly in discussion with them throughout their research cycles; providing advice on experimental design, assisting with analysis, bringing new insights to conclusions and always helping to articulate the findings in ways that can help those in downstream areas to make best use of the research outputs.

It was this incredible contribution to *Musa* genetics that gave the IITA plantain and banana team (Fig. 1.1) the edge in the race for the coveted King Baudouin Award in 1994; a biennial recognition of excellence in international agricultural research. Rodomiro's outstanding contributions in potato and *Musa* research were further recognized when he reached the final of the Prince Asturias Award for Technical and Scientific Research in 1997; widely considered to be the Spanish speaking world's equivalent to the Nobel Prize. However, no mention of these accolades would be complete without acknowledging the significant role played by the late Dirk Vuylsteke (who was tragically killed in a plane crash just a few years later). After all, it was Dirk who collected much of

Fig. 1.1. IITA *Musa* senior research team and graduate students (Onne, Rivers State, Nigeria, April 1994): From left to right: Dirk Vuylsteke, B.A. Ruhigwa, Bridget Akaeze, Rodomiro Ortiz, Kathelyne Craenen, Jonathan Crouch, Josephine Okoro, Julian Osuji, Friedhelm Gauhl, Cornelia Pasberg-Gauhl, K.N. Mobambo (photo: Ivan Buddenhagen). Missing from the picture: Piers Austin, Shaun Ferris, and Mwenja Gichuru.

the data that got Rodomiro started, it was Dirk who had the foresight to create the position and recruit Rodomiro, it was Dirk who had carried out the groundbreaking work on embryo culture techniques that was an essential precursor to the plantain and banana genetics research and breeding that followed, and, above all, it was Dirk who challenged Rodomiro every step of the way with his hard-earned practical experience from the field and his dedication to humanitarian goals. Rodomiro recounts "Dirk taught me that science was not only to be undertaken for the pleasure of finding things out—as I did when I was geneticist in Peru and United States before coming to Africa—but also we have a responsibility to our society while doing research for development." Thus, a new constant was added to the Ortiz publication brand that has remained to this day, that of conclusions to enable plant breeders to derive practical implications from his research outputs. When Norman Borlaug (Nobel laureate for his contribution to the "Green Revolution") spoke of the need for "venturesome scientists" to drive a new level of impact from international agricultural research for development, he must surely have been thinking about the likes of Rodomiro Ortiz.

Stories of the recruitment process that led to Rodomiro's appointment at IITA abound, such was the profound and unexpected impact that he made on most people that day. His response to one particular interview question seems to epitomize the whole experience. Dr. Margaret Quin (Director of the Crop Improvement Division (CID) at IITA during much of the time Rodomiro was at Onne Station), recalls "It was generally accepted at the time, that banana breeding was a dead end exercise—genetically fixed 3*n* gametes from tetraploid maternal genotypes crossed with diploid germplasm." So in the interview Dirk Vuylsteke described that the progeny from their 3*x*–2*x* crosses did not appear as the generally held model suggested, and asked what might be happening. As legend has it, Rodomiro's response rendered the interview panel speechless as without hesitation he delivered machine gun style, the precise proportions of 3*x*, 2*x*, and *x* gametes that should be produced from the maternal genotype. Margaret reflects that "having instant recall of that kind of information was for Rodomiro as natural as reaching for the right tool for a job from a toolbox."

Frances McDonald (Special Assistant to the Director General of IITA at the time) recounts another dimension of the day: "I had met with Rodomiro ahead of his recruitment process seminar, and as he talked to me in his normal fashion, with words tumbling over themselves fast and furious, in what he referred to as Spanglish—I wondered how he was going to present his seminar." It turned out that his seminar rendition was a little more paced and controlled but as the questioning became more

edgy, Frances recalls that the Ortiz machine shifted gear: "His answers became clear, sharp, and definitely not in Spanglish—and then he started his onslaught of the whiteboard. The more he was challenged, the more he completed his answers with formulae on the boards. By the time the Q&A session had finished, he had covered the entire wall, at least once."

From these reflections we can see that Rodomiro walked into IITA with an impressive armory of genetic and statistical knowledge. His deep understanding of half a century of research on ploidy manipulation in potato was to have a particularly dramatic and lasting impact on the global *Musa* research and breeding community. The complexity of inheritance in *Musa* was baffling to plantain and banana breeders until Rodomiro started unraveling the genetic systems of the genus. This was of course, largely due to the paucity of genetic studies caused by the high levels of sterility in the cultivated *Musa* germplasm.

Rodomiro's publication output in *Musa* started with a flurry of short papers in the regional newsletter that he had established 1 year after joining IITA (*Musa*frica), which was distributed free of charge to national research programs across Africa (and subsequently, upon request, to the global *Musa* research community as well). With highly constrained budgets and without the type of Internet access we are all so dependent upon now, this was one of the few new sources of *Musa* research information that regularly came across the desks of many African researchers throughout most of the 1990s. And through this medium, Rodomiro began a process of sharing preliminary research results with his local partners, long before they became available to the international community through journal papers. Not only was this a fabulous way to quickly build a strong network in that community, it was also an excellent way to raise the profile and value of robust research processes among that community. Soon many national program scientists and local staff at IITA, were using *Musa*frica as a stepping stone to international journal publications. Rodomiro's passion and dedication to this publication is just one reflection of his tremendous commitment to national programs and the people who worked in them.

The first *Musa* journal paper involving Rodomiro was focused on the yield loss caused by the black sigatoka disease that was devastating plantain production in West Africa at the time, and demonstrated the beneficial effect of the new resistant hybrids from IITA (Mobambo et al. 1993). This was followed in the same year by a paper describing the method used to produce this germplasm, based on 2 years of painstaking breeding work by Vuylsteke and Swennen, to which Rodomiro contributed his own data and analysis (Vuylsteke et al. 1993f). Not only had they identified 37 different seed-fertile plantain cultivars, they had

generated 250 hybrids from them and thereby convincingly dispelled the commonly accepted intractability of plantain to genetic improvement. Not a mean feat when you consider that it took 1,000 seeds, produced from hand-pollinations of 200 plants, to obtain one selected tetraploid hybrid. The 20 tetraploid hybrids selected from this work provided the foundation for the revolution in *Musa* genetics and breeding that was to unfold over the following few years.

The next plantain breeding dogma to fall was that the triploid female genome was effectively fixed in 3*x*–2*x* breeding schemes, with recombination only possible from the diploid male parent. Rodomiro had long since realized the potential for translating his experience in ploidy manipulation of potato and blueberry, for rapid impact in *Musa*. Thus, it was not long before he had demonstrated segregation in the triploid plantain genome during the modified megasporogenesis (Vuylsteke et al. 1993f) leading to the formation of 2*n* (=3*x*) eggs owing to a second division restitution (SDR) mechanism (Ortiz and Vuylsteke 1994c). And with it, the floodgates were open for dramatic new opportunities in *Musa* genetic analysis and breeding. The segregation in both haploid and diploid gametes in 3*x*–2*x* crosses was subsequently definitively demonstrated using microsatellite marker analysis (Crouch et al. 1998a). A confirmatory finding that I was not really inclined to write-up but that Rodomiro insisted should be published, whereupon it soon became a high impact paper cited by more than 50 subsequent publications. This experience completely transformed my perspective on publishing, a conversion that many scientists across the CGIAR were subsequently to follow as they too worked with Rodomiro.

The first complete genetic model for the genetic basis of sigatoka resistance across ploidy levels was published in Rodomiro's second year (Ortiz and Vuylsteke 1994c). Rodomiro and Dirk concluded that sigatoka resistance was governed by one major recessive allele (bs_1) and two independent alleles with additive effects (bsr_2 and bsr_3), and that the favorable resistance alleles have a dosage effect at the 4*x* level. Rodomiro recalls the night he figured out the inheritance model as almost an Arquimedes' Eureka moment. However, it seems that the heavy thoughts he was struggling with were too much of a burden for his house, as he and his bed fell through the floor that night. Many people have remarked that Rodomiro leaves a heavy footprint wherever he goes but this was certainly one occasion where the pun was highly apt.

Meanwhile, the pipeline of publications reporting the genetic basis of other agronomic traits in *Musa* was already in full flow, and would ultimately result in more than 20 journal papers, which Rodomiro has himself comprehensively reviewed (Ortiz 1995b). He even managed to

turn a genetic study of albinism into a substantial finding for evolutionary plant breeding schemes (Ortiz and Vuylsteke 1994b): that deleterious alleles (genetic load) are maintained in diploid gene pools owing to heterozygosity advantage and vegetative propagation.

It was at this time that I first experienced Rodomiro's incredible dedication to data analysis. Often finding him in the office late at night jumping between a first-generation PC at one desk and his pocket calculator, pencil, and paper at another desk. In the absence of computer power and the necessary software, he was carrying out complex multivariate analyses the hard way. For most people, this would have been excruciating torture but for Rodomiro it was a pleasure to be able to caress his data in this way. And of course, for Rodomiro, it was axiomatic that if this was the best way to analyze the data, then he just had to get on and find a way of doing it. These extraordinary efforts resulted in a number of papers on AMMI, stability and path analyses (Ortiz 1996a, 1998b; Ortiz and Langie 1997; De Cauwer and Ortiz 1998). Although once he had moved to the Royal Veterinary and Agricultural University (KVL) and gained access to supercomputers and SAS software, the level of his analyses made an exponential jump forward (Ortiz et al. 1998c).

During this time, he also published on a wide range of topics in *Musa* genetics and breeding including optimizing plot size (Ortiz 1995a; Okoro et al. 1997; Nokoe and Ortiz 1998), determining factors influencing seed set (Ortiz and Vuylsteke 1995b), evaluating the performance of tissue culture derived plants (Vuylsteke and Ortiz 1996), characterizing *Musa* germplasm (Swennen et al. 1995; Ortiz 1997c; Baiyeri and Ortiz 2000), analyzing genotype-by-environment interaction (De Cauwer et al. 1995a; De Cauwer and Ortiz 1998), studying leaf conductance (Ekanayake et al. 1998), assessing fruit quality (Ferris et al. 1999), preliminary understanding of the newly emerged banana streak virus (Ortiz 1996a; Dahal et al. 2000), and various studies with molecular markers (reviewed in Crouch et al. 2000b).

In addition to this incredible output of *Musa* research papers, and a steady stream of papers from his potato research at CIP and the University of Wisconsin, at the same time Rodomiro was also publishing was also publishing a series, a series of papers on tomato derived from a 3-month consultancy contract with FAO (that he carried out during the first months of his Ph.D.), as well as on blueberry from his 6 month stint as a cytogeneticist at Rutgers University before joining IITA. There seems to be no period of his professional life, no matter how short, that has not led to a series of papers—nothing is left to waste. Margaret Quin reflects "Rodo loves scientific knowledge, he likes to acquire it and then is always ready to use it—the knowledge is quite

literally 'at his finger tips'—where without hesitation, he scientifically squeezes the very last drop of conclusions from it."

Many colleagues also fondly remember the substantial positive influence that Rodomiro had on the performance of other researchers at Onne Station. Kathelyne Craenen, one of his Ph.D. students at Onne Station at the time (now Attaché Directorate-General for the Belgium Development Cooperation in the Democratic Republic of Congo) recounts Rodomiro's impact on Dirk Vuylsteke (her late husband) "He was the person who really challenged Dirk, pushed him to be sure about his work while at the same time believing in him to go outside his boundaries and become the scientist he was when he died." Dr. Julian Osuji was a young national researcher at Onne Station at this time (now Professor of Molecular Genetics and Cytotaxonomy, University of Port Harcourt, Nigeria), recalls that "Rodomiro had great initiative and vision, he loved good work and breakthroughs in research, and could drive a motivated person to great heights in research." Dr. Abdou Tenkouano who was recruited by Rodomiro as his successor, remarks "What I always appreciated most about Rodomiro was his availability—he always had time to discuss and provide guidance or encourage you to squeeze out the way forward from your own 'buried repository' of information."

From my own personal experience of working with Rodomiro at Onne Station (1994–1997), I can say that it was always a pleasure and a privilege to be challenged by him. He was constantly driven to apply his unwavering logic to get to the root of the issue at hand, open-minded to any new perspective despite never being without his own opinions, but always demanding watertight support for any new proposition. His passion for the scientific process brought a real sense of fun and excitement to research. He created a spark of synergy both when talking and writing together, that was often exhausting yet always addictive. He created an atmosphere where anything was possible but at the same time provided an aura that whatever mistakes you made, he would be there to fix the mess. This is a truly rare combination of talents that has challenged and inspired so many in the *Musa* research and breeding community at the time and far beyond ever since.

No discussion of Rodomiro's time at Onne Station could be complete without mention of his clean-desk policy. For someone who was writing so many papers while also managing the research station, it is incredible to recount that he never closed his office for the night without leaving his desk completely clear. This seemed to be less of a mental fixation and more of a biological necessity. Perhaps he could not clear his mind to sleep until he had cleared his desk of pending tasks. This was

awesome enough to experience in past eras dominated by pen and paper but continues to astound me that he is still able to apply this policy with his e-mail inbox that without exception will be empty when he shuts down his computer at the end of each day.

E. Nordic Professor of Plant Genetic Resources

At the beginning of 1997, Rodomiro took up the position of Nordic Associate Professor of Plant Genetic Resources based at the Department of Agricultural Sciences of The Royal Veterinary and Agricultural University (KVL), in Denmark, now merged into the Faculty of Life Sciences at the University of Copenhagen. This Professorship was funded by the Nordic Council of Ministers as part of an action plan to strengthen Nordic cooperation in genetic resources. The main research focus was in modeling genetic diversity in agricultural crop plants and their wild relatives in relation to *in situ* and *ex situ* conservation strategies and the sustainable use of genetic resources in crop improvement. In addition to research activities, Rodomiro also taught undergraduate and postgraduate courses and supervised a number of M.Sc. or Ph.D. students.

During the 27 months that Rodomiro was at KVL, he published over 50 journal papers as well as over 20 book chapters and newsletter articles. Of course, some of them were from his pipeline of publications on potato, *Musa* and other species from his research activities at previous organizations. Nevertheless, from little over 2 years research activities at KVL he would ultimately publish over 30 journal papers—about half of them while he was still at KVL and the other half over the following decade. A truly incredible level of productivity, and indeed Rodomiro's three highest annual levels of publication output—so far! Not surprisingly, most of his colleagues at KVL could scarcely believe that this level of productivity could be humanly possible. Many great statisticians and biometricians are not strong writers or struggle with the practical conclusions and implication of their analysis. However, Rodomiro uniquely combines strengthens in all three areas and beyond. He has attained the accolade of being a great agricultural scientist, geneticist, and biometrician and he has become a one-man scientific information exchange phenomenon through his publications and other communications.

Dr. Cary Fowler, who was Professor and Director of Research in the Department for International Environment & Development Studies at the Norwegian University of Life Sciences in Ås, Norway (now Executive Director of the Global Crop Diversity Trust) when Rodomiro

moved to KVL, highlights that Rodomiro also has a unique capacity to understand science, management, and policy at a high level. Cary recounts meeting Rodomiro at various conference events "I was always angling to sit next to Rodo because one could have a totally free ranging discussion with him that would be serious, clever, analytical, and insightful, having no natural limits on his side—it was always quite a remarkable experience." This is partly due to his incredible ability to read so much and to remember so much of what he reads. In addition, Cary reflects "Its unusual to have a confidant you can depend upon, fall back on, get advice from to such a degree when the majority of interaction is only by e-mail—he's really quite an extraordinary guy." I'm sure this statement resonates with many people who are fortunate enough to be in regular e-mail contact with Rodomiro. He has an incredible dedication to maintaining a personal relationship with a huge network of colleagues outside his organization and across the world, as well as constantly providing this group with new scientific information he has recently come across.

While at KVL, Rodomiro made important progress in the delineation of core subsets of germplasm collections that would form the foundation of his groundbreaking work on mini-core collections once he moved to the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) which was further refined when he subsequently moved to the IITA. The core collection approach had been used in a handful of crops during the late 1980s to mid-1990s. Rodomiro first used this methodology with Peruvian quinoa germplasm (Ortiz et al. 1999b), sweet potato germplasm (Huamán et al. 1999), and potato germplasm (Huamán et al. 2000a). The quinoa paper attained high impact status being cited in at least 60 subsequent publications. In this article, Rodomiro and coworkers used a geographically stratified nonoverlapping sampling procedure to proportionally allocate the accessions in relation to the relative importance of the quinoa crop as determined by its acreage in each respective area of origin. The sampling method also considered the morphological diversity on the large geographical clusters ($\geq$100 accessions), which was defined using independent principal component analysis. They also used biometrical methods to confirm the sampling process by assessing the diversity of all descriptors both in the entire and core collections, as well as determining that the most important phenotypic correlations among quantitative descriptors observed in the entire collection were preserved in the core subset. Critically, he then went on to independently validate that the core subsets identified did indeed represent a large proportion of the diversity in the entire collection using other biometrical approaches for

quinoa (Ortiz et al. 1999b). For the Andean potato core collection Rodomiro used a huge isozyme data set (Huamán et al. 2000b), and photographs of the germplasm diversity were used for the front cover of that issue of *Crop Science*. This article shows that the sampling strategy was adequate to include the most frequent allozymes of the entire collection because only rare alleles ($q < 0.0005$ or 0.05%) were lost in the selected core subset. The allozyme frequency distributions were also homogeneous for most loci, and the average locus heterozygosity was similar between the entire and core collections. This massively intensive approach across multiple crops epitomizes Rodomiro's relentless approach to the application of new methods, their rigorous testing and if appropriate, their large-scale application.

During this time, Rodomiro also moved into research of wheat, initially with a massive study of the phenotypic diversity in Nordic spring wheat cultivars released during the previous 10 decades (Ortiz et al. 1998b), which was followed by a molecular genetic analysis of the same germplasm (Christiansen et al. 2002). These studies confirmed the sustained genetic gain achieved by Nordic wheat breeders during this period but genetic relationships among the genotypes were not related to geographical origin or the decade of release. In addition, variation within clusters was always larger than between clusters. However, molecular analysis showed that genetic diversity in Nordic spring wheat was enhanced by plant breeding during the majority of decades of the 20th century. This paper attained high impact status being cited in at least 80 subsequent publications. Rodomiro was also involved in a parallel study of Nordic spring barley cultivars using a new phenotypic diversity index (Ortiz et al. 2002c,d). Contrary to the findings for wheat, 6-row spring barley cultivars clustered according to geographical origin or decade of release but this was not observed for 2-row barley cultivars. Similarly he branched out into lupin research, publishing a series of papers on the potential of landraces in the genetic betterment of the crop (Christiansen et al. 1999, 2000; Raza et al. 2000).

Rodomiro's research interests at KVL became further diversified through the highly productive Ph.D. research of William Wagoire, now Director of Research at the Buginyanya Zonal Agricultural Research and Development Institute in Kabale, of the National Agricultural Research Organization (NARO) of Uganda. Together they published seven journal papers, many in *Theoretical and Applied Genetics*, on yellow rust resistance (Wagoire et al. 1998a,b), environmental stress tolerance breeding (Hill et al. 1999; Wagoire et al. 1999a), and analysis of breeding schemes (Hill et al. 2000, 2001). Thus, confirming yet again, that Rodomiro could hit the ground running in completely new research

areas and inspire students and collaborators to become highly productive in their research outputs and journal publications. After finishing his Ph.D. at KVL, William returned to Africa where he identified the Ug99 strain of stem rust that is now threatening to devastate global wheat production. However, William's early identification of this new strain may have given the international wheat breeding community sufficient head start to beat this new threat. Meanwhile, Rodomiro continued to diversify his research activities publishing with former students or KVL colleagues in Brassicas, sweet cherry, lingonberry, and Napier grass.

Although Rodomiro had already contributed to a review of potato breeding (Ortiz et al. 1994a,b,c) and a major review of *Musa* breeding (Vuylsteke et al. 1997) as well as several book chapter reviews in both crops, during his time at KVL he significantly intensified and diversified his review writing activities. He published a major single author review of ploidy manipulation in potato breeding (Ortiz 1998c) as well as review of true potato seed (Ortiz 1997d), biotechnology in *Musa* breeding (Crouch et al. 1998b), the *Musa* genome (Ortiz 2000b), and *Musa* molecular breeding (Crouch et al. 2000b) plus the impact of cowpea improvement (Ortiz 1998a) as well as a number of more general reviews of genetic resources conservation and utilization strategies (Ortiz 1999a,b,c).

During his time at KVL, Rodomiro also had the opportunity to teach in Estonia at the Jogeva Plant Breeding Institute, in Finland at the University of Helsinki, and at the Agricultural University of Norway and to serve in Ph.D. dissertation defense committees at KVL and the Swedish University of Agricultural Sciences (SLU). In addition, he carried out consultancy missions in Sudan and Colombia for the IAEA. Finally, he accepted what was to become a string of invited editorial board positions for international journals, first with the *Electronic Journal of Biotechnology* (EJB), which he continues to this day.

F. Director of Genetic Resources and Enhancement at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)

In early 1999, Rodomiro took up the position of Director of the Genetic Resources and Enhancement Program (GREP) of the ICRISAT in India. At this time GREP comprised over 50 scientists and about 300 support staff working in India, Kenya, Malawi, Mali, Niger, Nigeria, Senegal, and Zimbabwe on sorghum, pearl millet, groundnut, chickpea, and pigeonpea. However, the institute was going through a widely reported mid-life

crisis triggered by an almost halving of its annual budget (from about $40 million in the early 1990s to around $20 million in the late 1990s) over the previous decade leading to massive staff cuts and concerns about the organization's future. As it turned out, this was exactly the type of challenge that Rodomiro was perfectly skilled to address: fundamentally rejigging essential human and financial resources to support new strategic objectives and cutting the rest. His dedication to science quality and accountability for efficiency and impact was of critical importance during this process. From the new strong foundation he created his program rapidly grew in all parameters.

Although he was only to be in this position for 2 years, his impact was dramatic including a threefold increase in per capita publication output of the program (from 0.64 in 1998 to 2.0 in 2000) and a fivefold increase in project funding for the program and its partners (from $1.1 million in 1998 to $5.7 million in 2000). Richard Jones, senior scientist for seed systems in GREP at the time (now Agribusiness Program Leader at the International Fertilizer Development Center, IFDC) considered that one of Rodomiro's greatest strengths was that he could combine a deep knowledge of the science of plant breeding with a clear understanding of how research could support development. In addition, Richard highlights "Rodo was never afraid to challenge the status quo, and he was a strong champion of work that put research into action. This made him a valuable asset at ICRISAT and for the whole CGIAR system, that has done good work but needs to be challenged, given the changing balance between public and commercial research, and the need to demonstrate measurable impacts on smallholder farmer livelihoods." Richard believes that these traits were key to identifying new research opportunities and effectively challenging scientists who despite doing good research were somewhat stuck in a rut. The result was that Rodomiro was able to unleash huge latent potential in many of his scientists. In 2003, the External Program Review of ICRISAT for the period 1998–2002 commended GREP (based on the strategy Rodomiro had implemented) for "its determined and unstinting efforts to bring to bear new science and tools for conservation and improvement of its mandate crops." "At the same time, leadership was provided to further develop the upstream biotechnology and genetic enhancement programme. Though young in its establishment, the center has shown that it can quickly claim a front seat in this competitive arena."

Nellooli Rajeskharan ("Raj"), who was Director of Human Resources at ICRISAT (now Director of Human Resources at the International Center for Agricultural Research in the Dry Areas (ICARDA)) watched Rodomiro rise to the challenge of growing from a scientist to a manager

when he joined ICRISAT. A scientist's success is based on achieving great precision in all they do but many excellent scientists do not make the transition to being a good manager because this requires a mindset able to make decisions based on incomplete information and a high degree of risk. However, as Raj highlights "Rodo has an outstanding capability in both areas, and even more uniquely, he is able to quickly jump between the two approaches based on need." For the scientists at ICRISAT, it was all the more impressive that Rodomiro could also continue to be a highly productive researcher in his spare time. This seamless blend of great scientist and great manager brought him tremendous credibility and substantial power of influence at ICRISAT. Rodomiro inspired people to achieve things that they hadn't even dared to dream they were capable of. Nevertheless, few could have predicted that just 3 months after joining ICRISAT, that Rodomiro would become Acting Director General of the institute. But Dr. Shawki Barghouti (now Chief Executive of the International Center for Biosaline Agriculture) had already seen something very special in Rodomiro when he recommended him to ICRISAT's Board of Trustee's for the acting Director General responsibility. As Shawki recalls "It was wonderful to see how Rodomiro was able to add value to a team's activities through playing a supporting role at the same time as being the team's leader." Rodomiro possesses that rare ability to make intellectual and wise contributions to any debate he participates in, irrespective of whether it is related to his own area of expertise, program, or institute. This is partly due to his solid logic but also his encyclopedic knowledge of a vast range of topics and his ability to translate that knowledge into valuable insights in other areas. As Shawki puts it "His inquisitive behavior, vast appetite for information, and intellectual sharpness makes him powerful at any level in any organization."

In science, there are no final answers, we are always in search of new answers and as Shawki reflects "Rodo is always in that mode, that you must continue searching for new answers—which is a fundamental component of his dynamism and the critical foundation of his productivity." As we have all seen, the pace at which Rodomiro can achieve change is tremendous, but he has always realized that there is no relationship between bureaucratic power and scientific power. As such his management style has always relied on science and logic as the powerhouses of change. Rodomiro is always curious to understand what everyone in his new home organization is doing—and since he has a great appetite for reading and a wonderful ability to connect with people, he acquires this new knowledge very quickly. Thus, he very soon has a solid helicopter view of the organization, and as Shawki puts it

"He is always running very fast to the top floor." But as Raj points out, one of Rodomiro's greatest skills is his ability to step out of his own personal areas of passion, and step back to see what is in the organization's best interest. Finally, of course, Rodomiro has never shied away from being clear about the standards he sets for himself and what he expects from others, particularly in the pursuit of accountability (for efficiency and effectiveness) and science quality, which are critically important elements for public research organizations. With this formidable portfolio of qualities, Shawki reflects that "There is very little risk in giving Rodo any level of position, as he will quickly rise to any challenge."

All of these professional accolades aside, there is another dimension of Rodomiro that must be highlighted, and that is the incredible loyalty and support he gives his friends. This is best illustrated by his actions following the tragic death of his dear friend Dirk Vuylsteke in early 2000. Dirk's wife Kathylene describes Rodomiro's support at this time and since "Rodo is my best friend in the world, and I do not know how to thank him. He changed our lives forever and I am greatly thankful for him being there and I will love him forever. After Dirk died he helped me survive this tragedy, supporting me in everything I did to take care of the children, finish my Ph.D. and build my career." Rodomiro also went to extraordinary lengths to finalize and formalize the Ph.D. dissertation that Dirk was working on at the time of his death. Dr. Abdou Tenkouano (who took over Rodomiro's *Musa* breeding program at IITA) sums up a feeling that resonates with so many of those connected to this story "Collating Dirk's papers and unpublished work into a thesis has tremendously increased my admiration and respect for Rodomiro—as a very rare testimonial of true friendship." And it is fair to say that there is a small army of people across the world who feel similar gratitude for their lives having been made significantly better thanks to their chance friendship with Rodomiro.

Professor Jules Janick (founder and editor of *Plant Breeding Reviews*) describes Rodomiro as "A large man with an enormous impact." The two first came into contact in 2000, when Rodomiro wanted to write a dedicatory chapter for Dirk Vuylsteke (Ortiz 2001b). Jules added " Rodo is a sensational person—so unassuming, that many who meet him for the first time do not realize how talented he is. Rodo is my hero! I don't know anyone who has published more and writes so well. He's on the editorial board of a number of journals including *Plant Breeding Reviews* and usually reviews and edits manuscripts within a day and in an extraordinary manner. He's the most amazing person that I know."

The local staff at ICRISAT particularly appreciated Rodomiro's straightforward and hard working approach. Rodomiro's administrative

assistant, Hanumanth Rao, recalls "Sometimes I used to stay late to finish the assigned jobs which I would e-mail to him before leaving. But without fail, the very next morning I used to find his responses and actions in my inbox. He was kind and caring for his staff and always greatly appreciated when they were proactive to solve problems or bring new efficiencies or reduce bureaucracy."

During the 2 years that Rodomiro was at ICRISAT he published over 30 journal papers, and more than 20 book chapters and newsletter articles. Of course, some of these were from his pipeline of research from other organizations. He would ultimately publish around 20 journal papers as well as about 20 book chapters and newsletter articles with ICRISAT colleagues. Most notable among these was the series of papers with the head of ICRISAT's Gene bank, Dr. Hari Upadhyaya. These focused on the development of mini-core germplasm collections for ICRISAT's legume crops that extended the work Rodomiro had started at KVL on core collections of quinoa and potato. First they published a paper showing the application of the methodology in the development of a mini-core for chickpea (Upadhyaya and Ortiz 2001). This paper published in *Theoretical and Applied Genetics* became a high impact publication cited by more than 100 subsequent papers. Rodomiro then went on to independently validate the methodology based on simulation analysis through a collaboration with ICRISAT's biometrician, Dr. Subhash Chandra, using data from CIP (Chandra et al. 2002). Subhash reflects on this paper: "Rodomiro was a very inspiring and supportive supervisor and mentor. The great motivation that he provided and the professionally challenging problems he often came up with resulted in the publication of one of my best papers that I feel very fortunate to have jointly written with him. Rodomiro knew the difference that the appropriate application of statistical science can make in objectively addressing scientific problems and in arriving at defensible and high quality scientific inferences." Subsequently, Hari and Rodomiro went on to publish on the development of core and mini-core collections for peanut (Upadhyaya et al. 2002b, 2003). The mini-core concept was devised to deal with international germplasm collections that typically comprised tens of thousands of accessions and identified subsets of a few hundred genotypes (just 1% of the entire collection) that represented at least 90% of the diversity of the main collection. At the time these germplasm collections were prohibitively large for effective use in plant breeding. It is fair to say that the formation of these mini-core collections revolutionized the use of genetic resources in legume breeding at ICRISAT, as just about every trait specialist focused their best phenotyping methods on characterizing these new

subsets of the germplasm collections. Great new sources of variation for the improvement of important agronomic traits were then discovered where researchers had previously reported no such variation was available. Thus, the manageable size of these subsets demonstrated that the quality of the phenotyping was yet again the rate-limiting factor to genetic gain for many traits in most crops.

Having made these significant advances in methodology and application, Rodomiro characteristically shifted his focus to new developments that would increase the application of these research outputs by the broader community. Specifically, the design and development of software to enable the formation of interactive core selections (Mahalakshmi et al. 2003). This work was carried out with Dr. Viswanathan Mahalakshmi, the bioinformatics scientist at ICRISAT, fondly referred to as "Maha", in collaboration with Dr. Theo van Hintum at Wageningen University. Until this time most potential users of core collections needed to rely upon the static general-purpose subsets formed by gene bank curators. However, geneticists and breeders could now create their own focused subsets of germplasm with a broad representation of the diversity within their chosen domain of interest. This software was made available for use on any of the CGIAR gene bank databases available on the System-wide Information Network for Genetic Resources (SINGER) and provided the foundation of a revolution in germplasm utilization. This was made possible by the effective integration of genetic resources, biometrics, and bioinformatics sciences. Most importantly, the analytical tools were provided freely to web-enabled users who previously were only able to access flat data files. This pushed gene banks into a kind of "open-source" world thereby empowering potential users to carry out an array of experiments limited only by their own imaginations, whereas previously most of this type of work was only carried out in gene bank research groups or in close collaboration with them. Although the announcement of this facility was only reported in a newsletter, the legacy of this work is enormous, as the functionality was readily available to everyone who visited the SINGER Web site. Moreover, this is a microcosm of Rodomiro's egalitarian approach to agricultural research for development, driven by his desire that his relentless searching for application opportunities for research findings should lead to a multiplier effect through benefits to the broader community. This will surely be his greatest legacy.

Rodomiro's research collaboration with Maha also resulted in groundbreaking advances in molecular genetic bioinformatics for ICRISAT's crops. They were the first in the CGIAR to pursue practical tests of the concept that bioinformatics could help translate molecular

genetic information in model species for the benefit of so-called orphan crops. Initially the process worked well for the link between rice and sorghum (Mahalakshmi and Ortiz 2001). And preliminary results suggested that the link between *Medicago* and ICRISAT's legumes would also yield well (Mahalakshmi et al. 2002a). However, it soon became apparent from subsequent molecular breeding application work that investments in model systems could not completely compensate for lack of investments in orphan crops. Nevertheless, the intensive and rapid work by Maha, her group and collaborators provided the foundation for convincing development donors of the need for scaling-up investments in genomics research of the orphan crops.

It is incredible to reflect, that before Rodomiro joined ICRISAT, Maha had spent many happy years as a senior plant physiology scientist. However, Rodomiro convinced Maha to apply her computational expertise first to gene bank issues and later to biotechnology challenges. Maha's incredible adaptability is only matched by Rodo's impressive skill for spotting such hidden strengthens and driving them into tangible outcomes. Although scientific research was only one of Maha's great strengths, as she also served as an invaluable sounding board and confidant as Rodomiro navigated the politics and positioning of senior management in a CGIAR center. A good example of Rodomiro's talent for finding and bonding with the individuals who can keep him in touch with the reality on the ground.

Rodomiro's time at ICRISAT also signaled the beginning of his ascendancy as a leading voice on the nexus between genetic resources, biotechnology, and plant breeding. This began with a series of review papers on transgenic crops in collaboration with the ICRISAT entomologist Dr. Hari Sharma and ICRISAT's two transformation specialists Dr. Kiran Sharma and Dr. N. Seetharama (Sharma et al. 2000, 2001a, 2002, 2003). Rodomiro and colleagues at ICRISAT also assisted the World Bank on the development of biotechnology-related aspects of their new strategy for agriculture and rural development, some of which was written-up as a journal paper (Dodds et al. 2001). During this time, Rodomiro also took on an enormous array of diverse administrative and managerial responsibilities including secretary of the Program Committee of the Governing Board, member of institutional Biosafety Committee, chairman of the task-force for the institutional intellectual property audit of ICRISAT, chairman of institutional Research Farm Committee, associate member of the Executive Committee of the Asia-Pacific Association of Agricultural Research Institutions (APAARI), and institutional lead on intellectual property matters.

G. Director of Crop Improvement to Executive Management at IITA

Despite his tremendous success at ICRISAT, Rodomiro was eager to get back to living in and working for Africa. At this time, Dr. Lukas Brader, the Director General of IITA, was eager to find a new director of his Crop Improvement Division who could bring in new talent and modernize the breeding programs as Rodomiro had done at ICRISAT. Naturally it was not long before the two were communicating about their respective aspirations and soon a deal was done. Lukas comments that "Rodo is a rather unique person having succeeded in developing himself from lab assistant to an outstanding scientist. He proved to be a more patient person than some colleagues might think. I do not remember having met another scientist who continuously and effectively worked such extremely long hours. This has contributed to his very very large publication record." Thus, on the 1 April 2001, Rodomiro moved from India to Nigeria to take up the position of Director of the CID at the IITA. At the time, there were about 40 senior staff in CID, most of them internationally recruited, working on the improvement of cassava, cowpea, maize, plantain/banana, soybean, and yam in Benin, Cameroon, Côte d'Ivoire, Malawi, Mozambique, Nigeria, Tanzania, and Uganda. This presented a very different challenge for Rodomiro, to keep his staff motivated and focused despite being based in so many different locations across Africa and working on such diverse crops. Although he traveled extensively to meet his scientists, it is probably during this time that he really developed his impressive email skills, which went from strength to strength and now allow him to maintain close contact with his vast global network.

While Rodomiro was busy in the senior management team of IITA, his publication pipeline was becoming more diverse, as he continued to publish work from all seven of his previous jobs as well as launching new publication pipelines with his new colleagues at IITA. During this three and half year period he published around 50 journal papers (incredibly over 20 as first author) plus over 20 book chapters and other research articles.

Combining sustainable resource management with the products of crop improvement and plant health research outputs formed the basis of a high impact publication that Rodomiro was involved in at this time (Sanginga et al. 2003). This paper reported on IITA's long-term efforts to intensify cereal–legume-based cropping systems in the dry savanna regions of Africa. The report focused on maize–soybean and millet–cowpea systems, demonstrating massive increases in land-use productivity leading to broad ranging economic and environmental benefits.

This paper epitomizes Rodomiro's passion for interdisciplinary systems-based approaches to agricultural research for development and still provides a critical framework for IITA's strategy going forward and for agricultural development in Africa as a whole.

The International Treaty on Plant Genetic Resources for Agriculture and Food entered into force in mid-2004 and drastically changed how the CGIAR centers managed and distributed the germplasm they held in trust for the global community. Rodomiro's passion for genetic resources research and utilization had already begun to diversify into work on international germplasm policy issues through his close professional interaction with Cary Fowler when they were both working in Scandinavia. Cary was also serving as special advisor to the Director General of the International Plant Genetic Resources Institute (IPGRI, now Biodiversity International), and upon moving to IITA, Rodomiro joined him on the Inter-Center Working Group on Genetic Resources of the CGIAR. Thus, Rodomiro joined forces with leaders on the subject in this group to write a detailed review of how they thought the new agreement should be interpreted regarding derivatives in order to best serve the stakeholders of the CGIAR system (Fowler et al. 2004). The focus of this paper was the definition of "derivatives," which was gathering global attention at this time, particular in the dialogue between public and private sectors. The issue was becoming critically important as ownership and control of crop germplasm was already defining the potential profits of commercial cultivars. However, for a global community used to working under more liberal systems of plant breeders' rights, limits to the availability of germplasm for use in breeding programs was greatly concerning gene banks across the world.

During this time, Rodomiro also starting scaling-up and diversifying his production of reviews, publishing 12 during this time (six as first author) from gene bank strategies to genomics and transgenics, and, from agrobiodiversity and breeding methods to technology transfer and agricultural development. He also joined the editorial board of the journal *Genetic Resources and Crop Evolution*. It was also during this period that Rodomiro was nominated by Jules Janick to become a member of the Committee for Research Cooperation (CRC) of the International Society for Horticultural Science (ISHS). The ISHS President at the time, Dr. Norman E. Looney, was eager to more effectively connect and engage the Society with the larger horticulture for development community. It goes without saying that his choice of Rodomiro to help in this initiative proved to be an excellent one as Rodomiro was very well connected (in both developed and the developing worlds), insightful and convincing. The CRC quickly learned to appreciate his

profound dedication to international agricultural research for development, as well as his pipeline for information and idea exchange from north to south. Dr. Jozef Van Assche the current ISHS Executive Director joins Norman in concluding "Accessibility, generosity and humanity are the traits that make Rodomiro Ortiz a living treasure for all of us interested in agriculture for development."

It was no surprise to anyone, that when the IITA management structure was reorganized in 2002, Rodomiro was asked by Director General Hartmann to serve as Deputy Director General and Director of Research-for-Development. Rodomiro describes his management style as open, direct, and candid, harnessing a positive competitive spirit. Dr. Ranajit Bandyopadhyay, a plant pathologist who joined IITA soon after Rodomiro, would rather describe him as "A maverick with a razor-sharp and logical mind." Rodomiro has a strong belief in functioning as part of a synergistic team, and has always tried to be associated with (or to create) "winning" research teams, that achieve success due to a shared vision with a shared commitment to agreed, relevant and achievable goals. As a Research Manager, Rodomiro gave freedom and incentives to "winning teams" to develop and execute plans for achieving the agreed goals. There was little or no interference in the work of people who did not need "fixing." Ranajit recalls that many scientists who joined IITA during Rodomiro's time had an informal "start-up" grant (something unusual in the CGIAR system) in the form of new capital equipment, staff, and projects. He also encouraged interdisciplinary team research by creating a small grant facility within IITA for innovative concept ideas that involve scientists from more than two disciplines.

Rodomiro considers there are eight areas critical to achieving such success: quality of science; vigorous resource mobilization; robust financial management; strong capacity and partnership building; constant dissemination of research results to partners; relentless technology exchange of research products; effective public awareness of the institute's work; and equal rewards for scientific breakthroughs versus impact in farmers' fields. And this is the manifesto upon which he based his leadership of research at IITA when he became responsible for around 100 senior internationally recruited staff working in 12 countries across sub-Saharan Africa with an annual budget of about $30 million (in 2003). Jenny Cramer had been special assistant to the Director General throughout the 1990s so knew Rodomiro from the time he was working at IITA Onne State. Jenny comments "His enormous capacity for work and his quest to know more about everything was quite staggering. But most of all I have come to appreciate Rodomiro for his availability and deep sense of commitment and loyalty to his family

and friends. I have witnessed him struggle with tragedy and observed with admiration as he steadfastly set about honoring his friend and colleague."

In this new position, Rodomiro led the reshaping of IITA's research-for-development agenda to be more orientated to the needs of target agroecologies using an integrated natural resources management approach, and to be more market- or demand-driven including an increased effort to assist in the commercialization of research outputs through agroprocessing, stimulating agroindustries and marketing. Rodomiro also championed the establishment of a Research-for-Development Council (RDC) to represent the highest ideals of IITA and to guard its scientific and programmatic quality across the Institute. In this new research management arrangement, the project coordinators were elected by project members. Many IITA scientists were asking for a more bottom-up style of decision making and so Rodomiro and Hartmann agreed on having elected coordinators. Of course, this type of approach strongly resonated with Rodomiro's own ideals, so it was a natural direction for him to champion. It is interesting to reflect how the seemingly unconnected experiences that Rodomiro had as a student activist campaigning for democracy in Peru in the 1980s, should become a crucial foundation to a dramatic shift in management structure in an international research organization in Africa nearly two decades later. A clear example of how great managers call upon all their life's experiences and skills, and seamlessly blend these with the best talents and ideas of those around them.

Jackie Hughes was a senior manager at IITA at this time (now Deputy Director General for Research at the World Vegetable Center (AVRDC)), and reflects "Rodomiro is one of the most technically adept scientists I know. His theoretical knowledge and his talent to apply that knowledge to development issues is outstanding. He has the ability to analyze and synthesize data without taking a breath. His writing is prolific, and his ability to generate manuscripts is amazing. During his time at IITA, if you didn't publish quickly he would assist you to do so!" Jackie's reflection cuts straight to the essence of the motivations for Rodomiro's incredible rate of publication—which is not about individual achievement but the pace and efficiency of collective progress, something that seems to be in his DNA and driving him every waking moment. In addition, Rodomiro was able to marshal his research teams at IITA to focus on deliverables, he led them to be very logical and output driven—and of course, publications oriented. He was widely revered for his ability to take decisions very quickly (without extensive non-productive discussion) and for his hardworking nature. Jackie recalls

"I used to think he had adjusted the time on his computer to make us think he worked all night. However, the reality was that he needed little sleep and did work through most of the night, and thus was on top of everything every day before mere mortals—who require eight hours sleep a night—had started to function." All these accolades aside, the thing that I still can't understand, despite nearly two decades of close observation, is how he keeps motivated 18–20 h a day, 7 days a week, 52 weeks a year, year in, and year out. Almost without exception, people who work this way either become slow in the luxury of the available time or become bored and fill their spare time with other things. Undoubtedly, Rodomiro is not an ordinary person.

During this time, Rodomiro also took on a diverse array of committee responsibilities from the Program Steering Committee of CGIAR Challenge Program "Unlocking Genetic Diversity in Crops for the Resource Poor" and the Drafting Committee of FARA (Forum for Agricultural Research in Africa) sub-Saharan Africa Challenge Program Proposal, to standing committees of regional or international initiatives on science and technology, germplasm conservation, sustainable tree crops and capacity building, as well as reviewing papers for journals and proposals for donors.

H. Research Director to Executive Advisor at the International Maize and Wheat Improvement Center (CIMMYT)

After three and half intensive and successful years at IITA in Africa and more than 15 years away from his beloved home country, Rodomiro was planning to spend some time in Peru before looking for a new challenge. However, he changed his plans after an offer from Dr. Masa Iwanaga, the recently appointed Director General of CIMMYT, to join him in rebuilding the organization that had spawned the Green Revolution but was on the brink of collapse after a series of financial calamities. The two men had a very special relationship developed over two decades since Rodomiro had worked with Masa in CIP in the mid-1980s before starting his Ph.D. The loyalty Rodomiro showed to Masa through this decision and throughout the following 5 years at CIMMYT was incredible to witness. Rodomiro has many personal and professional traits and capacities that are beyond the bounds of normal explanation, and his commitment to friendship is certainly one of those. Thus, in November 2004, Rodomiro moved to Mexico to take up the position of Director of the Intensive Agro-ecosystems Program (IAP) of CIMMYT and provide advice, upon his request, to the Director General in various scientific, management, and strategic areas. This program was setup to focus on

sustainable intensification of wheat- and maize-based cropping systems in densely populated areas where a large number of the world's poor live. Farmers in these areas tend to be highly market-oriented and driven by the need to sustain local communities and neighboring cities.

The Intensive Agro-ecosystems Program comprised about 30 senior researchers working in Asia and Latin America with a budget of around $9 million. The program was largely based on the former Wheat Program of CIMMYT with the addition of a few maize researchers and the groups working on conservation agriculture both in Mexico and South Asia. Intensive systems are usually irrigated and highly productive, featuring multiple crops (including large areas of maize and wheat). They also face serious challenges, including the unsustainable exploitation of water and soils, inefficient use of chemical inputs, and emerging or worsening disease and pest problems. Resolving these constraints in ecologically sound ways that maintained productivity was the primary goal of this program. The fifth External Program and Management Review (EPMR) (2005) of CIMMYT recognized that "IAP is in the forefront among all CIMMYT Programs in adjusting its structure to meet the new challenges facing CIMMYT." This panel also commended IAP "for its efforts to focus on the target regions where poverty prevails in densely populated areas."

Dr. Matthew Reynolds, the long-standing wheat physiologist at CIMMYT-Mexico used to refer to Rodomiro as a "walking encyclopedia," reflecting Rodomiro's deep, broad and up-to-date knowledge of a vast array of all relevant topics. This knowledge gave Rodomiro a real edge in just about any scientific debate, which many may not have enjoyed being on the wrong side of but this engendered deep respect and admiration among most. Matthew recalls "The most endearing quality of Rodomiro, is that in spite of his often very strong opinions, he always takes on an opposing point of view with good humor and enthusiasm, the mark of an open mind and a well tempered ego, qualities that are sometimes—ironically—quite rare in the scientific community." It was this type of approach that enabled Rodomiro to convene diverse opinions and facilitate the writing of a highly valuable balanced perspective on the contentious global discussion over the collision between food, feed, fuel, and conservation agriculture in maize and wheat production (Ortiz et al. 2006b).

Dr. Jose (Pancho) Crossa, the long-standing biometrician at CIMMYT, developed a particularly strong professional relationship with Rodomiro. Pancho fondly remembers how when library budgets were tightening, it was Rodomiro who could get hold of just about any paper—usually during the same day of the request. Not only does

this pay testament to his huge global network but also that there are so many people across the world only too happy to have the opportunity to do him a favor. Although Rodomiro has more accumulated air miles than anyone I know, it is his global pool of accumulated good will that is a uniquely marvelous thing to witness in action. Pancho reminds us of another side of Rodomiro, that so many have experienced in relation to different topics but here regarding their mutual first love of (soccer) football "Rodo knows the name of every player of every professional football team in Uruguay, Argentina, Brazil, Chile, Peru and across Europe. He knows the year one particular team won the national or international league and he even knows the name of the three referees on those specific games!"

During the 5 years that Rodomiro was at CIMMYT he published over 40 journal papers (15 as first author) plus nearly 30 book chapters and other scientific articles. This included eight major reviews, six of which were published in *Plant Breeding Reviews* (two of them as first author). Most scientists need a few years break after completing this type of major review. Moreover, few scientists are considered expert in a sufficient number of areas to be invited to write such reviews more often. Thus, it is all the more remarkable that Rodomiro seems capable of being almost continuously engaged in such writing tasks alongside all the research papers he writes and management responsibilities he holds. While at CIMMYT, Rodomiro was involved in a series of truly seminal research papers and thought provoking reviews that were associated with the management of important strategic institutional issues—in Rodomiro's world, everything is connected and everything should be mutually self-reinforcing.

First and foremost a trilogy of papers centered on the people, the genetics and the breeding systems associated with the Green Revolution that would substantially change the future of international wheat breeding. This evolved from an intense discussion between Rodomiro and the CIMMYT wheat breeders regarding evolution of the shuttle breeding systems that Dr. Borlaug had established and refined many decades earlier. Norman Borlaug had realized in the mid-1940s that Mexico offered a unique opportunity to test wheat breeding lines in highly contrasting locations—within the same country and in the same year. Not only did this offer great efficiency for the wheat breeding programs, Dr. Borlaug also found that this helped him breed widely adapted elite germplasm with a wide spectrum of disease resistances. It was this breeding system that provided the foundation of the Green Revolution wheat cultivars and the basis of CIMMYT's ability to generate elite material over the following half century for a global network of

more than 100 national wheat breeding programs (Ortiz et al. 2007e). However, after five decades of success from this approach, Rodomiro argued that the concomitant evolution in the needs and capacities of national breeding programs across the world justified a rethinking of wheat breeding schemes at CIMMYT. This was a sentiment that resonated with one of Rodomiro's coauthors on this paper, Dr. Richard Trethowan who was leading the breeding of wheat for low rainfall environments (now Director of the Plant Breeding Institute at the University of Sydney). Richard had already started sequential refining and testing of the shuttle breeding system to better serve the needs of his breeding targets. Dr. Maarten Van Ginkel was also a wheat breeder at CIMMYT at this time (now Deputy Director General of ICARDA) and recalls that for someone so new to the organization "Rodomiro's challenge of 'shuttle breeding' was considered an affront verging on blasphemy to many senior CIMMYT breeders. But of course Rodo was right in also putting sacred cows to the test of scientific rigor and impact track record." The "shuttle breeding" system was subsequently shown to be scientifically sound based on modern day concepts and had a proven record of changing livelihoods for millions of farmers. So the breeders had nothing to fear. However, in the process it did expose a certain lack of questioning one's own methodologies from time to time irrespective of their apparent success in the past, which is a good lesson for all of us.

There was no doubt that in this heated dialogue with the wheat breeders in his program regarding their future direction, Rodomiro was determined to have all the facts underlying their past strategies clearly laid out and fully interpreted. The background research that he and colleagues carried out toward this was published in the form of two major reviews: the genetic basis of the Green Revolution wheat cultivars (Trethowan et al. 2007) and a dedication chapter to Dr. Borlaug (Ortiz et al. 2007c). At the same time, CIMMYT scientists had been intensely studying the impact of CIMMYT wheat breeding programs in different global megaenvironments and together this led to a readjustment of megaenvironment focused breeding systems to encompass greater systemic participatory breeding by the national breeding programs and an increased focus on the needs of conservation agriculture production systems and grain quality traits for diverse specific target markets. It is fair to say that this was a major upheaval for the wheat breeders both logistically and psychologically. But it is testament to Rodomiro's commitment to getting all the facts straight as well as his relentless scientific logic and managerial prowess that he was able to broker a compromise agreement with CIMMYT wheat breeders for a definitive path of change.

The second groundbreaking area built on the foundation of half a century of archived phenotype data from the international elite spring wheat nursery testing system that CIMMYT coordinated with national wheat breeding programs across the world. This data set covered over 80 traits for more than 15,000 elite breeding lines tested at over 100 sites (mostly in developing countries). An estimated $500 million worth of phenotypic data but what made it really valuable was the maintenance by the CIMMYT gene bank of seed from most of the associated breeding lines. This opened the possibility of genetic analysis on an awesome scale even by Rodomiro's standards. First a pilot project was carried out with a subset of over 800 of these lines, which were subjected to intensive molecular marker screening. Then Jose Crossa embarked upon the daunting task of carrying out association analysis with 170 lines from this vast data set. The analysis took several days to run for each trait despite using the most powerful computers in the institute but the result was well worth waiting for. This work was published in *Genetics* and soon became a high impact publication cited by more than 100 other papers (Crossa et al. 2007) and launched exciting prospects of a new generation of open-source research where international databases were made available to the global community to use for novel experiments that perhaps no one at CIMMYT could ever have dreamt about. This was the best of cutting-edge research-for-development bridging north and south, with the best of old and new technologies for the rapid development of relevant outputs that breeders could immediately apply for the benefit of small-scale farmers across the world. The synergy and scale-up potential of this initiative, soon to be named the Wheat Phenome Atlas, strongly resonated with the Ortiz life-manifesto and he actively facilitated and championed the work of this group for many years to come. At the same time, Rodomiro was contributing to a major review of plant molecular breeding (Dwivedi et al. 2007), which greatly informed the thinking of the group regarding the practical implications of outcomes from the Wheat Phenome Atlas initiative. During this time, Rodomiro also led the writing of two reviews on maize and wheat genetics resources, crop evolution, and genetic enhancement (Ortiz et al. 2008b, 2010b). These research and reviewing initiatives led CIMMYT to start working in two new areas of fundamental importance to its future impact: the design of genome-wide selection systems for maize and wheat breeding (led by Jose Crossa), and the "Seeds of Discovery" for comprehensively characterizing the world's largest germplasm collections of maize and wheat.

Rodomiro had a tremendous impact on wheat research and breeding from just a single year as Director of the Intensive Agro-ecosystems

Program. He also had oversight responsibilities for the management of CIMMYT's field station in Obregón (Sonora, Mexico), which has been hosted by Patronato (the association of farmers, mostly wheat growers, in the Yaqui Valley) since the time of Dr. Borlaug. Patronato acknowledged the strengthening of their partnership with CIMMYT during Rodomiro's tenure as program director (facilitated by a sharing of culture and language), and presented him with a Yaqui award during 2006. During his subsequent tenure as Director of Resource Mobilization at CIMMYT, Rodomiro also established a strong working relationship with Dr. Víctor Villalobos, a biotechnologist who was at that time in charge of foreign affairs for Mexico's Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación (SAGARPA). Their collective efforts led to the launching of several collaborative research-for-development initiatives, including a large project on maize, conservation agriculture and training, honoring the late Dr. Borlaug. The SAGARPA funding for this project, which was to be led by CIMMYT, was approved at the eve of Victor's move to become the new Director General of the Inter-American Institute for Cooperation in Agriculture (IICA) in early 2010. This resurgence of Mexico government funding to CIMMYT laid the foundation for the subsequent larger and long-term project "Programa de Modernización Sustentable de la Agricultura Tradicional" (MASAGRO), which started later in 2010. During his first year at CIMMYT, Rodomiro was already playing a major role in the preparation of corporate level reports and medium-term plans, as well as becoming increasingly involved in a diverse range of fund raising initiatives and donor interactions. In addition, he was also a member of the technical or organizing committee of a number of conferences in Asia and Latin America.

In January 2006, the Intensive Agro-ecosystems Program was merged into the newly established global commodity programs designed under the new Business Plan 2006–2010. Rodomiro had been heavily involved in the development of this new strategy, and characteristically supported the new structure in the best interests of the organization even though it meant the dismantling of everything he had worked so hard to build during the previous year. The CIMMYT Director General then asked him to serve as the Director of Resource Mobilization, a position he was to hold until deciding to leave CIMMYT and the CGIAR at the end of 2009. In this new position, Rodomiro interacted with a wide range of governments, foundations and the private sector, as well as negotiating collaborative agreements with various partners associated with potential new joint projects. CIMMYT's fifth EPMR follow-up review team report commented positively on this transition: "This capture of an individual with a strong track record in fund raising

represents a positive investment in a more comprehensive and sustained approach to building a broader base of donors and project support." During the following 2 years, CIMMYT's grant proposal success rate improved by over 30% and the institute achieved its largest annual budget to that point of $43.5 million. Rodomiro was a master of packaging good new research ideas in ways that donors would understand and want to fund. Timing is everything in fund raising—not least due to the donors constantly changing strategic priorities, personal preferences and political pressures. Here Rodomiro's instant recall of everything everyone in the institute was doing and could be doing was indispensable when he was brainstorming with donors about which areas of CIMMYT research might best align with emerging funding opportunities. In addition, his dedication to providing donors with well-written and scientifically sound feedback notes was certainly instrumental in securing funding for many projects.

Soon after taking up this new position, the CIMMYT Director General asked Rodomiro to represent the institute in the CGIAR Alliance Deputy Executive—a committee charged with managing systemwide research strategies and initiatives, largely populated by Deputy Director Generals from each of the CGIAR centers. He subsequently became the first elected chair of this committee in 2008. Dr. John McDermott (Deputy Director General of International Livestock Research Institute, ILRI, at the time) was the second elected chair. John recalls that once in the chair role, Rodomiro quickly established systematic and productive processes for the operation of the committee and enhanced coordination with other executive levels of the CGIAR system including the World Bank. Rodomiro also coordinated the group looking at bringing systemwide efficiencies to research support during the CGIAR reform process. John highlights "Rodomiro was very helpful during the development of the Strategic Research Framework and the design of the new CGIAR Research Programs during the CGIAR reform process because of his encyclopedic knowledge of crop-based research—both biological and socioeconomic."

Foresight is at the core of any breeder's success, since it takes so many years to satisfy new end-user needs with new breeding product solutions. Strategic positioning is therefore a critical element of any agricultural research organization, and something that Rodomiro excels at, as it essentially relies upon taking calculated risks. In Rodomiro's logic, the level of the risk is substantially reduced by the quality of the calculation, and that relies heavily upon the robustness of the preparation. And thus it was with the climate change agenda that appeared prominently in the rhetoric of most agricultural research organizations

but often without tangible credible strategies for how specific research activities could make a difference. Rodomiro, however, characteristically tackled the problem head-on with discussions and research that were subsequently synthesized in an internal position paper on the issue, which was then published as a journal paper: "Climate change: can wheat beat the heat?" (Ortiz et al. 2008d). This was a very timely and valuable contribution for the broader community, clearly laying out a consensus interpretation of the extent of the challenge for different groups of wheat farmers across the world, then reviewing the current status in relevant mitigation and adaptation research. Not surprisingly it quickly became a high impact paper with more than 70 citations in other publications. In addition, the research findings were highlighted (and sometimes misquoted) in international media reports.

During this period as Director of Resource Mobilization, Rodomiro maintained an impressive publication output, despite not having an active research program behind him. Most notably, he led the development of highly interdisciplinary reviews on two new research priorities, which significantly raised the profile of these issues within the agenda of international development donors. First a trilogy on the collision between food, feed, fuel, and sustainable soil management (Ortiz et al. 2006b; Iwanaga and Ortiz 2007; Reddy et al. 2008). Meanwhile, he managed to bring together researchers from IITA, ICRISAT, CIMMYT and elsewhere to synthesize on-going research on mycotoxins and distill a consensus opinion on key priorities for this important aspect of food safety in international agriculture (Ortiz et al. 2008a). Rodomiro also joined the editorial boards of *Plant Breeding Reviews*, the *International Journal of Agronomy, GeneConserve*, *Journal of Biomedicine and Biotechnology*, and *African Journal of Plant Science*. As well as reviewing papers for other journals, reviewing proposals for donors, and joining the organizing committee of several conferences.

Around this time there was a change of Director General at CIMMYT, and Dr. Thomas A. Lumpkin took up the position in March 2008. For the next 2 years (bridging his departure from the CGIAR), Rodomiro served as a part-time advisor the new Director General on a wide range of strategic and policy issues as well as institutional representations and preparation of internal reviews.

I. Freelance Executive Advisor to National Opinion Leader in Peru

At the end of 2009, Rodomiro decided to leave the CGIAR system in order to pursue an intensive period of diversifying his experience

through working as an independent consultant, providing executive advice to a range of organizations across the world. There was an immediate, accumulative, and almost overwhelming flood of requests for his attention.

During this time he has provided extended periods of advisory services to the CGIAR Consortium Office and Consortium Board, the Director General of CIMMYT, the Director of the Generation Challenge Program, and the Deputy Director General of ICARDA, as well as joining external teams reviewing the International Center for Tropical Agriculture (CIAT), the Programa Cooperativo para el Desarrollo Tecnológico Agroalimentario y Agroindustrial del Cono Sur (PROCISUR), and the Instituto Nacional de Tecnología Agropecuaria (INTA) of Argentina.

Nellooli "Raj" Rajeskharan, Director of Human Resources at the ICARDA comments that Rodomiro was instrumental in helping ICARDA drive a fundamental realignment of available resources to support new strategic objectives. Raj reflects "Rodomiro is very good at determining what critical mass of what essential skills is required to deliver a given strategy, as well as defining what elements of the agenda need to be demand-driven versus project-driven." Dr. Maarten van Ginkel (Deputy Director General of ICARDA) recalls that Rodomiro was also asked to help facilitate a series of stakeholder meetings on the new Dryland Systems CGIAR Research Program, given his profound knowledge of the CGIAR and open-minded thinking. Maarten adds "But there was a huge additional bonus. I was utterly amazed to see how deftly Rodo could lead even large groups of nearly 100 people to share views and arrive at consensus. He draws in all present, including the more silent and reserved participants, giving all a place in the sun. He does not shun changing meeting plans around to accommodate exploring emerging relevant issues, while always staying on course. On the other hand, he rules with a stern hand when nonpriority issues threaten to dominate discussions, calling on transgressors to focus the debate, with a smile. Meetings he facilitates start with smiles and end with smiles: all feel consulted and all support the joint outcome. He is a master meeting facilitator."

Rodomiro was also contracted to develop modules for the e-learning course "Prebreeding to build capacity for more effective use of plant genetic resources for food and agriculture" of the FAO of the United Nations and for a range of other activities for the World Bank, the World Vegetable Center (AVRDC), the Institute of Biological, Environmental, and Rural Sciences (IBERS) of Aberystwyth University, and Red de Cooperación Técnica en Biotecnología Vegetal en América Latina y el Caribe (REDBIO).

Closer to home, when his international workload allowed, Rodomiro helped several organizations in Peru with development of publications and proposals, organization and facilitation of workshops, and as a visiting professor at UNALM—his alma mater. His M.Sc. supervisor, Prof. Francisco Delgado de la Flor comments from his recent interactions with Rodomiro "His open mind and brilliant loquacity has guided us through new paradigms. Everyone sees his great capacity yet few have recognized the impact he has had upon us but this acknowledgment will come in time."

During this 2-year period Rodomiro published nearly 20 journal papers and almost 30 book chapters, despite his heavy schedule of consultancy activities. This included a great resurrection in publications on *Musa* research. Perhaps most notably, a contribution to the improvement of *Musa* breeding systems based on data he was involved in generating 15 years early (Tenkouano et al. 2010a). This paper demonstrated that selection of agronomic traits in one cropping system was a reasonable prediction of selected line performance in another cropping system but not vice versa. We have commented many times in this dedication on Rodomiro's extraordinary ability to pickup on old data sets and generate meaningful new publications. After writing 85 journal papers from his 5 years research on *Musa*, most had assumed he had exhausted the publication possibilities. But as Abdou Tenkouano comments "our banana well still has a lot of water."

Rodomiro was also involved in an extremely diverse array of reviews in journals and book chapters, most of which he was invited to write or coauthor for a specific purpose that the editor or lead author felt he was well positioned to fulfill. In addition, he continued to review grant proposals for regional and international development donors, and manuscripts for various international journals. Among the many reviews he wrote during 2010 and 2011 were a series of high-level perspectives drawing upon his wide-ranging global experience. Starting with "The future of food" with colleagues from the International Food Policy Research Institute (Hubert et al. 2010), and then ranging from climate change (Ortiz 2010c; Reynolds and Ortiz 2010) and biofuels (Winslow and Ortiz 2010) to molecular breeding (Ortiz 2012e) and transgenic crops (Silva Dias and Ortiz 2012a,b). In addition, he synthesized the lessons learnt from the Green Revolution and translated them into recommendations for a New Green Revolution (Ortiz 2011b,d).

When Rodomiro returned to Peru at the end of 2009 and he began to visit various research organizations around Lima, he frequently found himself engaged in discussions about a possible formal moratorium on genetically modified crops. Luis Fernando Rimachi Gamarra and

colleagues at the INIA in Lima had already done their research and collected their data and were looking at how best to release the information more widely. Rodomiro had already accepted from INIA and others to give seminars or participate in debates about the pros and cons of transgenic crops in Peru. But meanwhile the Ortiz' publication machine sprung into action leading to a full research paper (Rimachi Gamarra et al. 2011a). However, it was the associated step of publishing a summary note in the journal *Nature* that really put the Peruvian debate on the international stage (Rimachi Gamarra et al. 2011b). But this was no ordinary situation, as the story had been simmering in the Peruvian press for several years. Most spectacularly landing one Peruvian scientist (Dr. Ernesto Bustamente) in court, where he was found guilty of defamation associated with the opinions he gave in media interviews regarding reports by the then President of the Peruvian Genetics Society of the presence of GM maize in a valley north of Lima. Now the INIA team had carried out a large-scale systematic experiment aimed at independently reproducing the disputed results. Of course, it is impossible to prove a negative but using widely accepted methods they were unable to detect the presence of GM maize cultivars growing in Peru. However, they did detect GM maize in animal feed samples which is not surprising since 1.5 million tonnes of maize grains are annually imported to Peru mainly from Argentina and United States where GM maize is widely grown.

The defamation case was subsequently overruled but the dispute continued, both scientifically and in the media, which was confounding the government's own policy debate. Rodomiro has always espoused the virtue of publishing straight scientific facts to inform public opinion and government policy. However, he cannot have imagined the level of public attention that this story would soon bring to him personally. Characteristically he rose to the challenge, seeing the need for an unbiased credible voice in this debate, and the need for someone to dispassionately translate the scientific debate for public consumption. Throughout 2010 and 2011, Rodomiro has regular appeared in interviews by the media, as well as relevant scientific fora. At first it appeared that political opinion might be swinging to a more open-minded position such as that seen in India, for example. President Alan García Pérez used his veto power in early 2011 to block the passing of a bill to establish a long-term moratorium on GM crops. However, with a newly elected president in place (Ollanta Humala), a revised bill was passed by Congress at the end of 2011 that legally prohibits the growing of GM-seeds in Peru for at least the next 10 years. As one Peruvian scientist said "Congress had the votes but not the science to argue

against GMOs for agriculture and fishery." It is proposed that during this time zoning of the country will be formalized (as in Mexico) and national capacity for monitoring GMOs in agriculture and fishery will be developed. Meanwhile, the new law does accept the import of GM-derived products for food, feed, and fiber. However, as Rodomiro's *Nature* article highlights, it is highly difficult to completely exclude natural or human-assisted seed movement across land borders, and thus it is probable that there are maize cultivars growing in Peru of unapproved foreign origin and it is inevitable that at some point this will include seed of GM cultivars. Unfortunately, the probabilities of these events are highly difficult to accurately estimate and even more difficult to convey to the general public.

IV. THE MAN

Rodomiro has a great natural inquisitiveness that drives him to be constantly searching to answer questions in every aspect of his professional life from science to management, and from policy to international development. His founding interest in mathematics, genetics, and biometrics has led him to apply a fiercely robust sense of logic to everything he does. He has combined this with an enormous appetite for reading and an equally incredible capacity to recall everything he has read. He applies his seemingly limitless memory to all things, and for example, he can relate every detail of meetings and events from decades ago—who did and said what, not to mention the life stories of everyone present. Dr. Shawki Barghouti, who was Director General when Rodomiro joined ICRISAT concludes "The breadth and depth of his exposure and interests is phenomenal—he is the antithesis of a silo man—he's an open field man."

Dr. Margaret Quin was Director of the Crop Improvement Division for much of the time that Rodomiro was working in the PBIP. Margaret recalls "Because he is so full of ideas and has such energy for work, he can appear to be something of a loner, and (conversely) not to be a team player—but actually he is. His energies and way of thinking (intellectual confidence) make it possible for good teams to prove that they are good and become even better. He keeps teams on their toes—and I respect that. Clearly, genetics is of major importance to Rodo's career satisfaction, but he is much broader than that, and that impressed me. He is not out solely for the pursuit of scientific knowledge with his name on it, as applies to some talented scientists. His aims, and the professional standards that he brings to the pursuit of these, include making

many people and organizations winners—quality and achievement for all aligns well with him."

Rodomiro has combined these qualities and skills with a strong dedication to derive significant practical implications from his scientific conclusions, as well as an awe inspiring ability to lead teams to outputs far beyond the sum of their parts. Built on this foundation is a remarkable ability to write and a relentless motivation to share his results far and wide that has been a fundamental part of his DNA since the earliest stages of his career. Dr. Mark Winslow who worked with Rodomiro at ICRISAT comments "Given his enormous publishing output, you might think he has a secretariat of skilled typists working under him. But he does it all himself. Not only that—he types with only a single finger of each hand. At a machine-gun pace!"

Rodomiro seems to be able to do everything twice as fast and for twice a long as most of those around him. His capacity for very fast reasoning and action, combined with his unmatched work ethic and perseverance plus his superb organizational skills has enabled him to quickly achieve tremendous success. He also has a remarkable ability and motivation to read up on issues in order to fill gaps in his knowledge and to thereby quickly become an expert in any field to which he turns his attention. And of course, he is able to bring together in a very short time the huge amounts of detailed information required for writing a paper.

One of Rodomiro's unique capabilities is to zoom in and out of diverse disciplines. He is equally comfortably to operate at any level and change between any of these levels very quickly. This is a very rare but incredibly important capability as most people get stuck at one of three levels: detail, conceptual, instinctive. Nellooli Rajeskharan ("Raj"), who has worked with Rodomiro at ICRISAT and ICARDA, believes this ability comes from his philosophy of life and a strong value system.

Dr. Ragnhild Sohlberg, who was the Chair of the ICRISAT board of trustees when Rodomiro was working at ICRISAT recalls "This was more than 10 years ago, when biotechnology was even more difficult and controversial than today, but Rodo 'kept his cool' while maintaining his professional stance. His expertise and devotion to the people he serves will be needed more than ever in the years to come." Dr. Gabrielle Persley, who was working for the World Bank at this time had a similar experience and comments "Rodomiro was the voice of sanity on IP and biosafety issues in the CGIAR." Despite the respect others have for his knowledge in a particular area, Rodomiro has always been driven to extend and deepen his knowledge. Initially at ICRISAT by attending the International Internship Program in Intellectual Property Rights and

Technology Transfer at Michigan State University and joining others in writing detailed reviews in biotechnology. And later while at CIMMYT, by twice attending the Agribusiness Seminars (an intensive case study-based course) at the Harvard Business School.

No discussion of Rodomiro would be complete without mention of his "clean-desk policy." This seems to be less of a mental fixation and more of a biological necessity. It seems he could not clear his mind to sleep until he had cleared his desk of pending tasks. This was awesome enough to experience in past eras dominated by pen, paper, and typewriter but continues to astound me that he is still able to apply this policy in the electronic age of information overload, particularly with his vast global network in 24-7 activity. Yet, as so many will bear testiment, you can expect to receive an email reply from Rodomiro the same day, and often with an hour.

V. THE SCIENTIST

In the early stages of his career, you would usually find amusing cartoons stuck to the outside of his office door, providing serious take-home messages about the type of thinking you should expect if you decide to enter. These might relate to science or management but one that reflects Rodomiro's philosophy on life is "Reality is only for those who lack imagination." In this vein, Rodomiro once said at one of his farewell parties "All of you who gave me friendships and accepted me as a tough colleague as well as a supporter of 'crazy ideas' that we dreamt and sometimes pursued with some success." Hard work and rigorous process toward stretch dreams, while all the time maintaining a realistic grasp on the probability of success, has been his lifelong trademark.

As a scientist, Rodomiro has managed to reach a perfect mental balance between pursuing the best available processes in his research and thereby being very confident in his conclusions versus always remaining very open to the possibility that at any moment new data may become available that completely changes the conclusion. In this respect, he has never been afraid of contradicting his previous conclusions if the experimental design and data analysis were sufficiently compelling. In fact, nothing would delight Rodomiro more, than finding the "exception to the rule" and breaking down widely held beliefs, irrespective of whether he had been involved with the inception of the original idea. For Rodomiro, above all things, the pursuit of the scientific truth has always been his greatest driver.

Frances McDonald recalls attending a seminar that Rodomiro gave early in his career at IITA when an eminent scientist in the audience presented him with a 10 min question. Whereupon Frances commented to the person sitting next to her "That would be my definition of complete scariness—having to try to answer such a question from that scientist" who replied "Oh no, no—not at all. Complete scariness would be to be up there trying to answer a question to Ortiz' satisfaction!" Many scientists become very opinionated about their points of view because they get too close to their ideas but Rodomiro can always challenge himself when someone challenges his ideas—he sees the challenge from a professional perspective rather than getting personally insulted that it is an attack against himself. However, in return he expects those around him to apply a stringent level of scientific process to their thinking and research.

VI. THE MENTOR, INSPIRER, MANAGER, AND MULTIPLIER

Carine Dochez, a VVOB (the Flemish Association for Development Cooperation and Technical Assistance) associate expert working with Rodomiro at IITA (now at the University of Antwerpen in Belgium) reflects "He is a great inspiration for young scientists, whom he encouraged continuously. With his great enthusiasm, he managed to get the best out of people. He made you believe you could do it. He is down to earth and always saying what is on his mind in a very straightforward manner. I don't know how he did it with his heavy workload and travel schedule, but he was always very supportive and helpful, even for the smallest question. If you sent him a question by e-mail he would always answer within a day." This constant lightening feedback is something that inspires everyone who comes into contact with him. Even after years of experiencing it, and now always half expecting it, nevertheless it is still always a pleasant surprise.

Subhash Chandra, biometrician working with Rodomiro at ICRISAT recalls "Rodo would go to any length to support relevant professional development that he believed would enhance the quality of science." And it was not just scientists that he inspired. Yannick Vuylsteke (the son of Rodomiro's dear friend Dirk Vuylsteke) recalls that Rodomiro had a significant impact on him through his generous character. Yannick reflects "It was when my father passed away that I really got to know Rodomiro. The older I get the more I realize the important role that he played for my family during a very tough time and I think it is safe to say that his dedication and support for us during this period was

unmatched by anyone else. Rodomiro is dedicated, funny, smart, at times unpredictable but his shining quality has always been his generosity—he has always been so generous with his time, with his humor, with everything he has been unbelievably generous. He wears his heart on his sleeve." It is fair to say that there is a small army of people around the world who feel the same.

"If you travel with Rodo you know well that you are not going to have an early night" says Shawki Barghouti, adding "he has so many of his old friends in every place across the world. You end up busy programmatically and socially. He is loaded with energy—makes everyone around him feel old but everyone wants to try to keep up with him. He is a dynamo of energy." So when with Rodomiro you don't have to worry about anything except when you can sleep. In contrast, he has the ability to sleep on a bus bouncing around dirt roads in Africa, perhaps for just 15 min and then he will spring into life for the next 18 h.

Margaret Quin recalls the review of her Crop Improvement Division soon after she arrived at IITA, that the report from Rodomiro was the first to be completed and turned out to be by far the largest! Rodomiro had interpreted the breeding and genetics data for plantain and banana in what was to become his signature manner. Margaret comments "He did not hover around a point, he simply stated what the data indicated in his opinion with of course relevant supporting information. He squeezed every last drop of juice from the fruit—with no hesitation." Margaret found this approach most refreshing as many of her scientists preferred to hold back somewhat, in case they might be wrong or only have a weak case to support their data interpretation. In contrast, Rodomiro preferred the view that "current science definitely supports interpretation X, Y, or Z, and if new information weakens such an interpretation in the future, fair enough, but for now, I am confident of my interpretation." Margaret very much appreciated this aspect of his way of working and adds "This approach had important spin-offs across the division as it stimulated others to think and make their case if they did not agree, it stimulated the application of rigor and was positive (supportive) for productive outcomes. It made science exciting and was an asset for planning new work." Undoubtedly, this is the "Ortiz-effect" wherever he has gone.

Many colleagues fondly remember the substantial positive influence that Rodomiro had on their performance and that of other researchers. Many have commented that it was often less like being managed and more like being mentored. Ranajit Bandyopadhyay, a senior plant pathologist at IITA, recalls "I have had the good fortune of knowing Rodomiro as a boss and a friend but he did not make me feel that he was

the former, although he knew how to keep professional and personal relationships separate. He guided me and provided avenues to grasp opportunities that he thought would foster my professional interest as well as the institute's mission." From a personal perspective, my interactions with Rodomiro, albeit often exhausting, have always been exhilarating, and have brought me the most rewarding challenges of my career. Although I have not always delivered upon them to his satisfaction, and yes of course, there's still a handful of data sets from our research together that I have still not written-up, which he still occasionally reminds me about.

Rodomiro has always been absolutely clear from the outset about his position on quality of science. No one can ever complain that they weren't warned what was coming. He was always very clear about what he expected, what standards he set for himself and what he would expect from others. He never tried to be politically correct, he was simply driven to find the truth in science and use it for impact in the fields of resource-poor farmers. Thus, his passion for a rigorous scientific process was sometimes misinterpreted by people who felt threatened by his high standards and levels of productivity. Consequently, Rodomiro has tended to polarize every organization he has worked for, from top to bottom. Personally, I have always felt it was a privilege and a pleasure to be challenged by him. He made research an exciting endeavor through challenging you to be more efficient, more effective, and of course to have more impact but always with an underlying sense of excitement about the potential prospects for science and resource-poor farmers. Mahalakshmi who worked with Rodomiro at both ICRISAT and IITA always compared his management style to a knife "blunt of one side and sharp on the other." Conversely, Rodomiro has always highlighted a different component of his management style "Impatience is a virtue" particularly in the context of his self-proclaimed crusade to address pernicious insidious mediocrity across the CGIAR. Shawki Barghouti reflects on one of Rodomiro's most misinterpreted management skills "Rodo understood what people need—not that he would necessarily be sympathetic to them. Thus, people who were looking for sympathy rather than understanding were often disappointed."

Margaret Quin tells us "I think of him as 'Restless Rodo'—always thinking, always reviewing needs and priorities and putting them into shape as plans for the future. Forward, ever forward, and how best to move to move forward—for me, that is an important part of Rodo." Rodomiro has achieved so much as an individual but he has achieved so much more through building and motivating teams. Shawki Barghouti tells us "Rodomiro knows more about the CGIAR than anyone and he

can keep the fire under the feet of the scientists." Rodomiro's multiplier effect is greater than anyone I know. Perhaps three or four times in my life, when I have been at the top of my game (usually after much support and encouragement from Rodomiro), I have momentarily had a glimpse of what its like to be Rodomiro. Except he manages to maintain this intensity 24-7, through at least 350 days a year, year after year, decade on decade. And the cumulative effect of this extraordinary effort is like trying to conceptualize the scale of galaxies.

As a manager, Rodomiro has inspired many individuals through direct working relations. However, during the past decade he has exponentially increased his reach through artful use of e-mail. Most notably, he has maintained an incredible personal global network through his regular e-mail circulars. Sharing information from Web sites, newsletters, and new publications. He has been connecting people and ideas as well as keeping everyone up to date with each others' developments, and facilitating countless new opportunities. This is something he was doing long before blogs and Linked-in, and something that huge numbers of people benefit from on a weekly basis. This is an activity that takes up his time without any guarantee of personal return and is indicative of his constant wish to reach out to share and brainstorm on new ideas while challenging, testing, and refining old ideas. This type of activity makes Rodomiro a tremendous asset to any organization and the world at large—his commitment to the power of knowledge and the multiplier effects that new technologies can bring to that.

VII. THE FUTURE

Despite overwhelming demand for Rodomiro's advisory services and his wide-ranging successes through operating in this arena, this style of working soon lost its glamour not least due to the nomadic globe-trotting required, often just moving from one country to another. In addition, despite his extraordinary ability to achieve so much through his own efforts, this one-dimensional operational environment was missing the challenge of team building, the thrill of capturing synergy, and the satisfaction of driving the multiplier effect. These are the pillars that have characterized the multidimensional teams he built and led over the previous two decades: bringing collective discipline, focus and competitive intensity to his teams, helping them create synergy in order to generate better ideas and solutions, and driving their multiplier effect to provide greater impact for resource-poor farmers. Recapturing the excitement in science that we all felt during our Ph.D. research and

creating an "everyone wins" environment, powered those teams but also fueled Rodomiro himself. Thus, at the end of 2011, Rodomiro moved back to academia in Scandinavia, this time as Professor of Genetics and Plant Breeding at the Swedish University of Agricultural Sciences.

It is too tempting not to draw parallels with his time at KVL (Denmark) in the late 1990s that laid the foundations for his dramatic rise through the ranks of senior management in various CGIAR centers, and to wonder how his time at SLU (Sweden) might be followed by a similar trajectory in the higher echelons of international development organizations. However, many think that academia is now the environment where he can have his greatest impact. Shawki Barghouti comments "Rodo will be fantastic in the university system because he has so much knowledge that he can impart to the next generation." Undoubtedly this is true, as perhaps Rodomiro's greatest unmeasurable impact has already been his ability to inspire people to dig deep and dream high, to challenge themselves to attempt to achieve things they never imagined were possible, and above all to support them in their journey toward those new goals. Cary Fowler believes that Rodomiro will play a role at a conceptual level determining where the gene bank of the 21st century is going. Plant breeding is changing so dramatically and there's so many developments in the gene bank world, that the static 1970s view of gene banks is now completely outdated. Cary predicts "We need new relationships and a different sense of purpose for the gene banks in the context of new science and breeding—and new challenges. This is the type of situation in which Rodo excels."

In true Ortiz fashion he has already laid down his manifesto for the coming few years (Ortiz 2012g). His starting point, of course, is that international and regional agricultural research organizations must address the challenges of sustaining food security, alleviating poverty, and protecting the environment, by being proactive in their role as bridges, brokers, and catalysts in rural development. He highlights that the use of crop-related genetic resources remains limited due to the lack of systematic and holistic research to provide a comprehensive set of tools and strategies for the routine, rapid and efficient identification and introgression of beneficial variation into plant breeders' gene pools. The critical missing link here is a new generation of plant breeders with the right interdisciplinary skill-base. Thus, Rodomiro concludes that education in plant breeding should emphasize research and training in conservation and characterization of genetic resources as well as evolutionary plant breeding systems and integrated cropping systems-orientated thinking—in addition to exposure to the techniques of modern computational and biotechnology sciences. Only in this way

can we hope to fully harness the new paradigm of knowledge-led plant breeding in order to achieve the level of increase in pace and scope of impact from seed-embedded technologies that is required for crop production to keep pace with increasing global population. The conversion of data to knowledge to skills to impact lies at the core of this approach, and is of course what Rodomiro has been supremely successful at throughout his career so far. In addition, Rodomiro highlights the need to educate and sensitize the general public and policy-makers to better understand the science that has been deployed to revolutionize food production over the past century, and to appreciate what is needed to maintain this level of progress. Clearly, Rodomiro plans to keep busy.

Although much has changed over the last half century, these are broadly similar to the goals that led Norman Borlaug to fuel the Green Revolution, and drove the Ford and Rockefeller Foundations to establish the CGIAR system. In his 1970 Nobel Peace Prize acceptance speech Dr. Borlaug commented "I am but one member of a vast team made up of many organizations, officials, thousands of scientists, and millions of farmers." Yet as Norman Borlaug has shown us and as Rodomiro continues to prove, one man can make a difference. As Bill Gates said "As we look ahead into the next century, leaders will be those who empower others." And thus in dedicating volume 40 of *Plant Breeding Reviews* to Rodomiro Ortiz, we look forward to his continued leadership in the field, and we hope that it will inspire and empower us to improve the lives of the billions of people who go hungry ever day.

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