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BIODIVERSITY CONSERVATION : PLEA FOR ECONOMICALLY USEFUL TREE AND SHRUB SPECIES*

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I am thankful to the Indian Society of Genetics & Plant Breeding for inviting me to deliver today this Dr. B. P. Pal Memorial Lecture.

In fact, I do not need an invitation to talk about Dr. Pal, nor do I need a particular occasion to do so. Ever since I first met him, a half century ago, in 1937, there has not been a day when I have not fondly remembered him, or narrated to my friends one or the other aspect of his numerous qualities of head and heart. For, Dr. Pal was not just a good scientist, or an especially able science administrator, he was indeed a many-splendered personality, each facet superbly fascinating and endearing.

By Almighty's grace, I have, all along in my life, been blessed with friends, dear friends, and nothing but friends. Whether during my 40 years at the Indian Agricultural Research Institute (IARI), or whether during the very valuable and rewarding spell at the Indian Council of Agricultural Research (ICAR) headquarters, when I had the pleasure and privilege of visiting research centres, agricultural universities and other research establishments literally in every nook and corner of our country, I have had the most pleasurable experience of adding to the brim to my treasure of dear, dedicated and dynamic friends.

Having said this, I however must admit, and tell you, that the very thought of two, the dearest among them all — Dr. Pal and Dr. Harbhajan Singh — bring forth tears welling into my eyes. That could be the reason why, for today's talk, I have chosen a subject dearest to them both. And dearest to me too, with my close 12-year association (1974–86) with the International Board for Plant Genetic Resources (IBPGR) headquartered at Rome in Italy, which commenced spearheading its dynamic global endeavour on plant genetic resources since 1974.

But this twin choice of talking about Dr. Pal and Dr. Harbhajan Singh, and talking about plant genetic resources activity places on me a heavy and difficult burden and responsibility,

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that of sticking to a timeframe of less than an hour. For, on each one of these two topics, even a full day would not suffice for me. Brevity is always desirable, but it is difficult to achieve in this case. However, let me make an attempt.

It is a common experience with me that I often recall past events they come before my mind's eye, as vivid as the flash-backs in many feature films. In 1937, when I first went to IARI, I recall my first meeting with Dr. Pal. An unusually handsome person, very very soft-spoken, reserved in nature — like a typical Englishman. But, even in those days, he opened up to select colleagues and even to students, opening as a flower does. I remember being invited many times during my post-graduate student days to his Bungalow No. 9, to show us his rose collection (he had 500 distinct varieties of roses even in those early days), play table tennis (ping pong, as it was called those days) and drink light tea with vegetable pakoras (he was very fond of them). In those 'Imperial' days, this was not expected of an Imperial Economic Botanist! Dr. Pal was a man of few words, he was generally inapproachable, conversations with him were always brief. He was a disciplinarian, yet he would be friendly and helpful in appropriate cases. He provoked none, and was never provoked himself. He was polite to every one, gave a seat to whomsoever called on him — a fieldman, a student, or an officer. Throwing about weight was never his nature. Flattery did not please him, and of course, he flattered none.

Although a prestigious Class I 'Imperial' Officer, he rode to his office on a bicycle. In those early days, all 'Imperial' Officers, and even some Class II officers, possessed motor cars. But not he. He travelled to New Delhi and other parts of Delhi in the city bus — the company was GNIT (Gwalior and Northern Indian Transport). We used to call it 'Goes Never in Time'. His alternative transport was a tonga and his particularly favourite tongawala was Langra tongawala. He never asked for the use of official motor transport. He bought his first, and last, personal motor car in 1950 when he became Director IARI.

He was always correct in his behaviour. In 1958–59, when I became the first Dean of the IARI Post-Graduate School, there used to be two Councils at the Institute: one, the Institute Council (for administrative business), and the other, Academic Council (for academic matters). He used to chair the Institute Council and I was a member. In the Academic Council, I was Chairman and he was a member. Later, this arrangement was changed. Once, after my retirement, he sent me a reprint of his article in a foreign journal, on roses. My wife liked it very much, and wrote to him for his permission to let her translate it in Marathi. His response: he sent her the address of the editor of that journal and advised her to seek his permission. She did accordingly.

Dr. Pal was an unusual Punjabi (people had to be told he was one). A life-long confirmed bachelor; a strict vegetarian (not even eggs); a complete tee-totaller; a non-smoker. He loved music intensely — both western and Indian classical music. I spent hours in his drawing

room listening to recorded music on his gramophone, in complete silence. But he would only listen to the kind of music which he wanted, and not something dished out, as on the radio or later on TV. This was why he did not own a radio or a TV set. No refrigerator in his house (he drank water from out of the desi matka) !

Keenly interested in fine arts and crafts. He was an office-bearer of the All-India Fine Arts and Crafts Society (AIFACS) in Delhi and had many artist and painter friends. He himself was an excellent painter. Water colour was his medium, and his grace, delicacy and softness were reflected in his paintings many of which he gifted to select friends without pomp or show, but with personal affection. The vivid paintings by famous painters, like Roerich, Kanwal Krishna, and Elizabeth Sass-Bruner, which are today displayed on the walls of the IARI Library buildings, were obtained as gifts from those painters themselves, by courtesy of Dr. M.S. Randhawa. His handwriting was extraordinarily beautiful, and his handwritten notes were a sight for the Gods to see ! In whatever he did, there was a quiet grace, finesse and dignity. The annual convocations of IARI have always been famous for their grace and dignity. At their source was Dr. Pal. After every convocation, and after every major function at IARI (where the guests were offered nothing but lovely bouquets of select roses, gladioli or chrysanthemums), personal letters of thanks would go from Dr. Pal to members of the various committees set up for those occasions.

His love for flowers and gardens was unique. It is very well known. So is his fame as a breeder of roses and bougainvillaeas. The garden in his Bungalow No. 8 was perhaps the best private garden in Delhi. It was fondly visited and admired by luminaries, like President Zakir Hussain, President S. Radhakrishnan, Prime Minister Indira Gandhi, Dr. C. D. Deshmukh, and others. They came on their own and did not need invitation. After he went to Krishi Bhawan in 1965, as the first Director General of ICAR, he moved to his personal residence in the Hauz Khas area of New Delhi. Not having any ground space there for gardening, he continued his rose and bougainvillaea breeding work on the terrace, which soon became a riot of colours. In his last will and testament he gifted his house and all his rose and bougainvillaea collections to his own institute IARI! Another gracious act of his was to lay down that his driver-cum-cook, who had faithfully served him till the end, could live in the house throughout his life. Lord! What a man... What a man !

Dr. Pal's stories, jokes and limericks have been famous. In this he had no parallel. He regaled his audiences with select ones, each chosen so as to be appropriate for the occasions. But they were spontaneous. He had a huge stock of them, and I now regret I did not make a compilation of them all. His stock contained what was termed 'vegetarian' as well as 'non-vegetarian' jokes. But they always were innocent, and never acid. His audiences roared with laughter on hearing them, but his own response was a suppressed smile and a characteristic blush on the face. I recall members of the ICAR Botany Committee, of which

he was Chairman for many years, would not let him conclude a meeting without at least one joke or story.

As a scientist, he always believed in cooperation and coordination in research. Developing his then very well known N.P. 700 and N.P. 800 series of wheat (he was the first to start wheat breeding for rust resistance in India), he actively cooperated with IARI scientists, like Dr. B. B. Mundkur, and with eminent scientists elsewhere, like Dr. K. C. Mehta of Agra University. This conviction laid the foundation of national cooperative endeavour in research under ICAR's All-India Coordinated Crop Improvement Projects, launched during the 1960s and later, when Dr. Pal was Director General of ICAR.

As a science administrator, he was a great visionary, indeed a seer! During the 1930s (he became Imperial Economic Botanist at IARI in 1936), he set up the Wheat and Potato Breeding Station at Shimla, and the Tobacco Breeding Station at Guntur in Andhra Pradesh. In those days, the famous Sugarcane Breeding Station at Coimbatore, was a part of IARI. It is important to note in this connection that Dr. Pal was essentially an institution builder, and not an empire builder! He was not possessive. That is why, in later years, he readily agreed to let the Sugarcane Breeding Station become a full-fledged, independent Sugarcane Breeding Institute (SBI) at Coimbatore. The potato breeding station became the Central Potato Research Institute (CPRI) at Shimla and the tobacco breeding station Guntur developed as the Central Tobacco Research Institute (CTRI) at Rajahmundry in Andhra Pradesh.

In his own IARI, wherever he saw real scientific competence and leadership, he encouraged it to develop into full-fledged sections and, later, into Divisions. Thus, Dr. R. D. Asana's pioneering researches in plant physiology led to the establishment of the Division of Plant Physiology; Dr. Harbhajan Singh's, first into the Division of Plant Introduction and, later, into the full-fledged National Bureau for Plant Genetic Resources (NBPGR) at New Delhi; Dr. N. B. Das's and Dr. K. C. Gulati's research units became the Divisions of Biochemistry and Agricultural Chemicals, respectively. When he saw the immense potential of nematological research, he established the Division of Nematology, against much resistance from the Heads of Divisions of Entomology and Plant Pathology.

The best example of Dr. Pal's far-sightedness was the recognition, fifty years ago, of plant genetic resources and their crucial importance in plant breeding research. He established at IARI the Section of Plant Introduction, as early as during the 1940s, under the then Division of Botany, and asked Dr. Harbhajan Singh to lead it. He forged active collaboration with international plant introduction centres, for example, with the CSIRO's in Australia and with the USDA's establishment at Beltsville in the U.S.A. He also saw to it that all important collections of potato germplasm, made during the 1930s and in later years,

by the British Empire Potato Collecting Expedition (led by Dr. J. G. Hawkes) in Mexico, Peru and Bolivia, became available to IARI's potato breeding station at Shimla. During the 1920s and 1930s, the world renowned phytogeographer, Dr. N. I. Vavilov of Russia, had drawn attention of the world to the importance of plant genetic wealth residing in the world 'centres of origin' and 'centres of genetic diversity'. Dr. Pal firmly believed that genes were the essential building blocks for those engaged in erecting the future edifice of plant breeding research in the world!

Under Dr. Harbhajan Singh's leadership began systematic collection and exploration work in India. Dr. Singh shared many personal qualities with Dr. Pal — a quiet personality, sincerity, dedication and hard work. He too was soft spoken and a gentleman to the core. The introductions of vegetable materials made by him during 1940–1960, led to the identification and commercial release of a number of vegetable varieties, many of which are unbeaten even today. He was what I call a born collector and he was careful enough to identify a band of colleagues similar to him — R. K. Arora, M. W. Hardas, B. S. Joshi, T. A. Thomas, M. N. Kooper and K. P. S. Chandel, to name some. This team made extensive collections from all over India, including the northeast, and from Nepal, Bhutan, and some African countries.

During the Second Five Year Plan, the Section of Plant Introduction was built up by Dr. Pal into a plant Introduction and Exploration Organisation, in the hope that forestry research institutions and the Botanical Survey of India will cooperate in developing a single, comprehensive national genetic resources organisation. Unfortunately, they did not oblige. Hence, the nomenclature — first, the Division of Plant Introduction at IARI, and later as the National Bureau of Plant Genetic Resources (NBPGR). I must record here that the dynamic Dr. Rajender Singh Paroda gave a big push to NBPGR when he became its Director. He developed the sophisticated long-term germplasm storage facilities, with funds from ICAR and from the Department of Biotechnology, and made plans for the laboratory buildings. Later, his good work has been continued by the present Director, Dr. Rai Singh Rana. I do hope ICAR and Dr. Rana will name the new NBPGR buildings, when they are completed, after Dr. B. P. Pal, and its first-rate gene bank, after Dr. Harbhajan Singh.

That evil can come from good, is an old adage. It started coming out true in respect of plant genetic resources work too, especially during the post-World War II years. As crop improvement research progressed more dynamically, in developed countries and in many of the developing countries, including India, a real threat came to be perceived. Far-seeing crop improvement research scientists began to realise that, as newer and newer cultivars and hybrids were bred all over the world, and spread fast, far and wide over farmers' fields both in the developing and in developed countries, the older varieties would fall into disuse and hence would soon disappear and be lost irretrievably.

These older varieties, and especially the 'land races', although they were less productive than the modern varieties and hybrids, had the distinct advantage of adaptability to diverse soils and climates through prolonged cultivation over vast areas; they also, for the same reason, had a good measure of tolerance or resistance to biotic stresses (pests and diseases). Hence, there was an urgent need to collect and conserve them before they were lost to mankind.

Also came under serious threat the valuable plant genetic wealth residing in the centres of origin and centres of crop genetic diversity (delineated by Vavilov). The threat came from the extensive clearing of vast stretches of primaeval forests (e.g., in the Amazon Basin in Brazil, and elsewhere in the world) to meet the ever-growing needs of burgeoning human populations, to meet the ever-increasing residential and industrial needs, but, alas, also to satisfy not just human need, but to quench human greed!

As in India, the research establishments in many countries of the world (e.g. the USSR, the USA, the U.K., Australia, Germany, France, Japan) were already engaged, during the first half of the present century, in making systematic collections of plant genetic wealth for utilisation in crop improvement research. But, especially during the last two or three decades, it was realised that this endeavour must be significantly stepped up and speeded up on a global scale, for saving world's plant genetic wealth from getting lost for ever. Therefore, it was considered that a global network of plant genetic resources must be developed quickly. This led to the establishment, in 1974, of the International Board for Plant Genetic Resources (IBPGR) at Rome in Italy under the umbrella of the Consultative Group of International Agricultural Research (CGIAR), established in 1972, with headquarters at Washington D.C. in the U.S.A. During the last 20 years, IBPGR has dynamically spearheaded this activity on a global scale and has supported extensive and intensive germplasm collecting expeditions in all the continents of the world. Excellent support to this task was given by the IARCs (International Agricultural Research Centres) established in many developing countries of the world under the auspices of the CGIAR (examples: IRRI in the Philippines, ICRISAT in India, ICARDA in Syria, IITA in Nigeria, CIAT in Colombia, CIMMYT in Mexico, CIP in Peru). These institutes now hold world collections of crops for which they hold mandate. Countries like China, the Philippines, Indonesia, Thailand, also have actively joined in IBPGR's endeavour. Today, it can safely be stated that, in respect of genetic wealth of world's major crop species, almost everything that needed to be conserved, has been collected and conserved. Please note that all this has happened long before the clarion call on Biodiversity and its Conservation was given last year at the Earth Summit held at Rio de Janeiro in Brazil.

But, even then, a large and significant gap still remains, for which I wish to make a fervent appeal at this National Seminar: conservation of genetic diversity residing in a large number of economic tree and shrub species in India. IBPGR tried to give a fillip in this

direction during the latter half of the 1980s, with cooperation from the Forestry Division of the FAO and from other institutions and agencies, like ICRAF (International Centre for Research in Agroforestry) and UNEP (United Nations Environmental Programme), both in Kenya. Some efforts, but not enough, were made in India too by ICAR. Even so, not even the surface had been scratched. The forestry research institutions and the Botanical Survey of India do not seem to consider it as their job. I do not know if ICAR (as also NBPGR) view the task with the seriousness it deserves! Many of the economically useful species of trees and shrubs, including many medicinal plant species, are inherently out-pollinated. Examples: neem (*Azadirachta indica*), oil-yielding peelu (*Salvadora oleoides*), tamarind (*Tamarindus indica*), jackfruit (*Artocarpus heterophylus*), some species of bamboo, jamun (*Syzygium fruticosum*), kokam (*Garcinia indica*), aonla or amla (*Phyllanthus emblica*), nutmeg (*Myristicafragrans*), chironji or charoli (*Buchanania* spp.), ber (*Zizyphus mauritania* and related species), karonda (*Carissa carandas*), sajan or shevga (*Moringa pterygosperma*) and many others. Therefore, their seed cannot be used for genetic conservation (except as gene pools). They have to be propagated vegetatively (budding, grafting, cuttings, tissue culture). Studies made in India and in other countries have shown that the range of genetic variability in these species is indeed very vast. For example, oil content in neem has been reported to range between 20 to 70% and azadirachtin content between 2 and 9%. In case of peelu (*Salvadora oleoides*), oil content and valuable lauric acid content has shown a range of 100 to 200% variability. So on and so forth. Criminal vandalisation of our forest areas poses a serious threat to the very existence of this valuable genetic wealth. A tree standing today, may not be there tomorrow. And what would be lost are not just trees, but their treasurable range of genetic variability. For, each tree in these out-pollinated species is genetically distinct from the others — those standing even in their neighbourhood. They must be collected and propagated for conservation (today, and not tomorrow) in *ex situ* conservation nurseries. The importance of germplasm collections of medicinal plants has already been stressed at a number of international gatherings held in recent years, in which India has actively participated.

Extensive, well-protected facilities of land, on a permanent basis, will be needed for the establishment of comprehensive national germplasm collections of these useful tree and shrub species. ICAR today does not have at its command such extensive resources of land. I would therefore earnestly urge the Director General, ICAR, to get in touch with the Union Ministry of Environment and Forestry (which has under its control the Department of Forestry, the Department of Wasteland Development, and the Botanical Survey of India) and forge strong linkages with them to make progress in this important and urgent task. That Ministry has vast lands at its command.

And, don't you consider this line of activity as just one of academic interest. Let me tell you that, even if one or a few worthwhile accessions are identified among these collections, *they could provide valuable recipes for making our wastelands sustainingly remunerative!* They

indeed could veritably transform the present dismal ecological scenario in our country into stretches and stretches of 'green gold'! Add to this the fact that all this activity could be a bankable proposition.

The Indian Society of Genetics and Plant Breeding has indeed done well to organise here this important seminar on strategies in plant breeding during the 21st century. Any worthwhile plant breeding research endeavour, as you will appreciate, cannot sustain its progress unless it is backed up by abundantly variable plant genetic resources. This, therefore, should actually be the key item in our future plant improvement research strategy. Again, the extensive plant genetic wealth that has already been collected from all over the world (and the collection work must continue well into the future) would be of no value if it just sits pretty as accessions in gene banks, in those long-term cold-storage facilities. A frozen bank account is of no value to the depositor. Plant genetic wealth is as good as nonexistent, if it is not systematically evaluated, catalogued, and utilised. Dr. Nyle Brady, a former Director General of the International Rice Research Institute (IRRI), coined the acronym GEU, meaning genetic evaluation and utilization. Without GEU, he used to say, even the best of germplasms are valueless. The task begun in India by Dr. B. P. Pal and Dr. Harbhajan Singh some forty years ago must not weaken or end. We still have 'miles to go'. It must be continued, even more vigorously, into the 21st Century. Doing so would only be the most appropriate and the most fitting tribute to the memory of Dr. Pal and Dr. Harbhajan Singh.