

## Crop Genetic Resources and International Relations: A case of USA and Japan

By

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With all of the attention that biodiversity and genetic resources manipulation is now receiving, it is disconcerting to note how rarely one sees reference to the basic concepts upon which technologies currently revolutionizing agriculture today depend, namely: the collection, evaluation, conservation, maintenance, and distribution of genetic resources. Although these principles remain a crucial constant in the present situation, from a public point of view, their role has been diminished greatly.

It is also important to note that while a significant portion of the world's irreplaceable genetic diversity originated in the developing countries, not all research successes relate to germplasm from such countries. A case in point is the little-known contribution to world food security that has resulted from an ongoing collaboration between two developed nations—Japan and the United States—that began long before their governments were adversaries in World War II.

Two U.S. plant explorations to the Japanese Empire in the late 1920s held great significance for American agriculture. The U.S. Department of Agriculture (USDA) sent Dr R. Kent Beattie, a plant pathologist, to eastern Asia to study the oriental chestnuts (*Castanea mollissima* and *C. crenata*), which were found to be resistant to—or at least tolerant of—a chestnut blight fungus (*Endothea parasitica*) that was then ravaging the U.S. native chestnut (*C. dentata*). Beattie spent four years (1927-30) studying the disease in Taiwan, Korea, China and Japan, during which he enjoyed exceptional cooperation from Japanese scientists. He was able not only to send great quantities of chestnut seeds to the U.S. for research purposes, but also to provide extensive observations on the culture of the chestnut and the nature of chestnut blight in the Orient. While native chestnut is rarely seen in the U.S. today, the oriental chestnut has become a familiar sight throughout the country. Researches also report that there currently appears to be a major revival of chestnut research underway, based largely on the trees derived from Beattie's collections.

During his years in the Orient, Beattie also focused considerable attention on Japanese nurseries and botanic gardens, sending home plants and seeds of native plants that were accompanied by detailed commentary on nursery activities. Although Beattie is scarcely known among researchers collecting in the Orient today, it was his meticulous day-to-day diaries that provided the rich details of Japanese horticultural activities; scientific resources in the forestry agencies and botanic gardens; and Japanese customs. This and other information was essential to the success of my first exploration to Japan in 1955.

In 1929, USDA sent a team of two well-traveled collectors—soybean specialist W.J. Morse and P.H. Dorsett, a close companion and fellow plant collector of the legendary David Fairchild, with whom he had traveled earlier throughout the Orient—to study the soybean (*Glycine max*). Morse and Dorsett collected extensively through Japan, Korea, Sakhalin, and Manchuria over a two-year period, returning with almost 3000 varieties of soybeans. The value of having obtained these materials during the period before WWII when the soybean was becoming a major oilseed crop in the U.S. cannot be overstated. In addition to soybeans, the two explorers also collected other legumes, wheats, barleys, and grasses. While in Japan, they were also able to make a comprehensive study of venerable flowering cherry trees.

### Post-war Relationship produces Landmark Study

Following World War II and a lapse of 20 years since U.S. plant collectors and botanists had visited Japan, occupying U.S. military forces encouraged the renewal of such scientific relationships between the two countries. Under the Natural Resources Section of the Supreme Commander for the Allied Powers, technical assistance was put in place to increase the potential for renewed self-support in Japanese agriculture. This assistance included various agronomic, economic, botanical, and forestry programs that brought scores of American scientists to Japan. Botanical research was also conducted under the Civil Administration of the Ryukyu Islands.

By the program's end in 1952, more than 58 studies dealing with all aspects of Japanese agriculture had been published. It was perhaps the most comprehensive study of the agriculture and related matters of one country ever conducted by any occupying power. A number of Japanese scientists, particularly those who spoke English, were employed in these programs, which were viewed as a financial boon given the general lack of other employment available to them. The collection and exchange of plant resources and related botanical studies between American scientists and their Japanese colleagues during the post-war years was of exceptional benefit to the understanding of the natural and economic plant resources of Japan and the Ryukyu Islands. The work was carried out in the early 1930s, when relations between the U.S. and Japan began to be strained.

## Japan's Semi-Dwarf Wheat Triumphs in Post-war U.S.

In 1946, Dr. S.D. Salmon, leader of wheat-breeding research for the USDA, was detailed to the military government to help familiarize in leaders with the scope of Japanese national agriculture. During a courtesy visit to the Marioka Agricultural Research Station on Honshu, Japanese scientists insisted on giving Dr. Salmon a comprehensive tour. As a wheat breeder, he was particularly interested in seeing field plots where selections of Japanese semidwarf wheat were in controlled experiments. Salmon, was impressed by the large heads; the strong, heavy straw; and the general vigor of the wheat plants. He wondered if the semi-dwarfs wheats, with their strong stems, might solve the problem of "wheat lodging", which was causing farmers in the U.S. Midwest to suffer considerable losses. When Dr. Salmon returned to the United States, he brought with him a number of 10-gram wheat samples and planted them in isolated, disease-free conditions. One sample—"Norin 10"—was selected for further experimentation in a joint USDA/Washington Station project at Pullman, Washington. Thus, in 1952 a 15 year research program based on the "Norin" wheat introductions from Japan began under direction of Dr. O.A. Vogel, a uSDA agronomist. After "Norin 10" was crossed with "Brevor", a wheat variety that was popular in Washington State at that time, additional crosses were made, and the results of field tests were evaluated. In 1956 a selection named "Gaines" was announced.

To make the long story short, 18 years after Dr. Salmon had found "Norin 10" on the far-away island on Honshu, Japan, exceptional yields—as much as 15 to 25 percent greater than in prior years—were being reported by farmers in the Palouse area of the Pacific. By 1967, "Gaines" dominated the Pacific Northwest winter-wheat harvest, covering 2.5 million acres, or 61 percent of the total acreage planted.

### "Norin 10" Transforms Agriculture of Mexico, India, and Pakistan

"Norin 10" then moved into the international arena, playing a major role in "the war on hunger". Experiments to develop semi-dwarf wheats first were undertaken in Mexico by Mexican scientists and Dr. Norman Bourlag, the Nobel Peace Prize Laureate who ultimately was awarded the Nobel Peace Prize as a result of the "Green Revolution" launched with his Mexican colleagues. Funded by the Rockefeller Foundation, their research was based on some of the Norin 10 germplasm Dr. Bourlag had received in 1949 from Br. Vogel. By 1960, Mexican-bred semi-dwarf wheats, derived from the original Norin stocks, were in commercial production, thus increasing Mexico's mean wheat yields from 11 to 40 bushels per acre.

The great success of the Mexican semi-dwarf, Norin-based wheats soon attracted attention in the East, specifically in India and Pakistan. By 1966, both countries were producing their own varieties of semi-dwarf wheats based on initial foundation seed imported from Mexico. The success of semi-dwarf wheats was phenomenal—countries doubled their wheat production in fewer than ten years, thereby benefitting their peoples both economically and socially. The direct descendants of the original (Norin) germplasm provided to Dr. Salmon in 1946 at Japanese experiment station became important to all wheat-producing countries, and have been incorporated into new varieties with higher number yields and greater disease resistance. H.F. Culver summarized this remarkable research—initiated by the collection of ten grams of Japanese wheats—in an unpublished study.

### Sweet Potato Success

Dr. Victor Boswell, a USDA vegetable-crop specialist, was another American scientist who arrived in Japan during the military occupation. In 1946 Boswell was sent to study vegetable-crop production, practices and requirements, focusing particularly on the sweet potato because it was then Japan's number-two food crop and was widely cultivated in the U.S.. Richard Cocks of the British East India Company was among the first to introduce the sweet potato into Japan in 1615.

The sweet potato became a significant survival crop for the war-ravaged Japanese people in the Post-WW II period because of its unsurpassed productivity per unit area of land (especially considering the shortage of fertilizers available then). Dr. Boswell undertook a thorough study of Japanese sweet potato cultural practices that included propagation methods, soil requirements, fertilizers and field culture, harvesting, the storing and drying of tubers, diseases and related crop methodology. He introduced into Japan a number of American sweet potato varieties and brought back to the United States a number of Japanese varieties which he believed had nematode—and disease-resistance potential. For both countries, this exchange of germplasm provided extremely valuable tools for crop improvement.

### Valuable Survey of the Rich Vegetation of the Ryukyu Islands

Egbert H. Walker's botanical mission to Okinawa and the southern Ryukyu Islands in 1951 was of a somewhat different nature. Walker, whose work focused on the botany of Eastern Asia, considered the Ryukyu Islands a significant link between the flora of Japan and that of Formosa and the extensive tropics beyond.

Except for the naturalists with the Perry expedition (1852-53) and the collections by Charles Wright during the 1853-54 naval explorations to the North Pacific, Walker's

was the only botanical exploration made by Americans to the Ryukyu Islands. Walker's expedition was made possible by funds from the U.S National Research Council/National Academy of Sciences and the U.S Department of the Army.

Two veteran Japanese botanists, S. Sonohara and S. Tawada, joined the Walker expedition. Together they made a remarkably extensive vegetation survey of the islands, collecting over 8000 herbarium specimens and publishing a study under the auspices of the U.S Civil Administration of the Ryukyu Islands. This study, "Important Trees of the Ryukyu Islands", was of great assistance in agricultural and forestry programs aimed at establishing a study of self-sufficiency through the importation of exotic plants of economic value. It was Walker and his Japanese colleagues who advised me during my own collecting mission on Okinawa in 1955, for which the military provided similar logistical support.

### **Agro-climatic Studies of Japanese Vegetation Made Significant Contributions to Plant Exchange**

Perhaps one of the most positive out-growths of the search for solutions to the urgent rehabilitation needs of the war-deveasted agricultural areas of Japan was an agro-climatic study of Japan's natural vegetation and field practices as they related to analogues in North America and post-war, plant-introduction problems. This comprehensive study was detailed in a report by M.Y. Nuttonson, a senior USDA agronomist associated with the American Institute of Crop Ecology ( a research organization devoted to problems of plant adaption and introduction). It defined distinct agro-climatic conditions in various parts of Japan and compared them with various regions of the U.S. in order to identify areas of climatic similarity.

Published in 1951 under the Auspices of the military government, the study greatly affected later plant-exchange programs and offered clues to the success of plant materials transplanted from one area to its climatic counterpart. This provided a practical agricultural context for the results of early studies by Professor Asa Gray (done after the Perry expeditions to Japan), and the process of identifying analogous climatic situations between Japan and Eastern North America became an extremely important tool in evaluating plant introductions for potential adaptation. In addition to the studies in Japan, 12 additional agro-climatic studies were produced on Eastern European countries and the Soviet Union.

Another Japanese botanical scientist who was employed by the military government during this period was Dr. H. Takeda. A distinguished botanist renowned for this study of the alpine flora of Japan, Dr. Takeda also had an excellent background in English, having matriculated from the University of Edinburgh. He published a systematic list of economically significant Japanese plants, one of the few papers prepared by a Japanese scientist among the many published under military auspices during this period.

Dr. Takeda was still employed by the U.S. military at the time of my first collecting in Japan, and he traveled with me throughout southern Japan and the remote island of Yakushima, a remote volcanic island south of Kyushu, Japan. Among the many collections this exploration yielded was a rare relative of the common crape myrtle, *Largestroemia fauriei*; this Yakushima native was unknown in cultivation at that time. It was later discovered, during evaluation by Dr. D. Egolf of the U.S. Arboretum, that the tree was resistant to the common powdery mildew that had disfigured crape myrtle foliage and flowers. The accession ultimately became a parent of all modern crape myrtle cultivars in the American nursery industry.

### **Recognition of U.S. Japanese Collaboration Long Overdue**

The several years of U.S. Japanese collaboration before WWII and the period of military-sponsored agricultural research between Japan and U.S. after the war scarcely have been recognized for their remarkable contributions to world agriculture. Yet their initiatives paved the way for subsequent civilian plant-exchange activities over the ensuing decades and helped the Japanese appreciate the value of collaboration in the international field of plant exploration and introduction.

One very important dividend from Japan's awakening role in international assistance affairs was the establishment of the Japanese Agency for International Cooperation in Agriculture (JAICA). This world-renowned development agency now functions in ways similar to the U.S. Agency for International Development (USAID), particularly in Southeast Asia. Japan went on to become a member of the International Board of Plant Genetic Resources (now the International Plant Genetic Resources Institute), as well as the Food and Agricultural Organization. Today, Japan plays an ever increasing and influential role in both scientific and developmental programs aimed at conserving crop genetic resources and has become one of the world's major sources of support for international collaboration vital to these efforts .

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