

Fragaria germplasm: The “Professor Staudt Collection”



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INTRODUCTION

Germplasm collections require at first a strong will for the conservation of plant material. Such collections are valuable investments only if they are properly maintained, constantly evaluated for trueness in terms of taxonomical descriptions and used for all kinds of research and breeding. Today, parts of Staudt's living collection of *Fragaria* species are maintained in various places worldwide, thereby, promoting the conservation of strawberry germplasm. Staudt worked on more than 300 in vivo accessions and additionally studied the collections of many important herbaria in the world. He classified 24 species of the genus *Fragaria* including three nothospecies. Their taxonomy and phylogeny based on chromosome numbers, branching of stolons, crossing experiments, sex expression, pollen morphology and geographic distribution. Günter Staudt was involved in strawberry research ranging from molecular and cytological studies to extensive breeding programmes in the US, France and Germany. According to his will, Günter Staudt's scientific collection and his private living plant collection have been transferred to Dresden, Germany, being curated by the author. The living plants are maintained in the germplasm collection at the Hansabred Breeding Company in Dresden under his name as “Professor Staudt Collection”. They are used for breeding and for taxonomical investigations. Günter Staudt's most valuable herbarium specimens are kept in the herbarium of the Botanical Museum Berlin-Dahlem, Germany.

Tab. 1. Number of species accessions at the “Professor Staudt Collection”, sex, fertility, and ploidy level.

Species	Number of accessions	Sex/Fertility	Ploidy
<i>F. xbijfera</i>	16	hermaphroditic	diploid
<i>F. bucharica</i>	2	hermaphroditic*	diploid
<i>F. xbringhamstii</i>	1	hermaphroditic	enneaploid**
<i>F. cascadenis</i>	28	heteroecious/dioecious	decaploid
<i>F. chiloensis</i>	68	heteroecious/dioecious	octoploid
<i>F. chinensis</i>	18	hermaphroditic*	diploid
<i>F. corymbosa</i>	8	heteroecious/dioecious	tetraploid
<i>F. daltoniana</i>	1	hermaphroditic	diploid
<i>F. gracilis</i>	4	heteroecious/dioecious	tetraploid
<i>F. inumae</i>	1	hermaphroditic	diploid
<i>F. iturupensis</i>	2	hermaphroditic	decaploid
<i>F. mandshurica</i>	9	hermaphroditic*	diploid
<i>F. moupinensis</i>	3	heteroecious/dioecious	tetraploid
<i>F. moschata</i>	87	heteroecious/dioecious	hexaploid
<i>F. nilgerrensis</i>	12	hermaphroditic	diploid
<i>F. nipponica</i>	14	hermaphroditic*	diploid
<i>F. nubicola</i>	8	hermaphroditic*	diploid
<i>F. orientalis</i>	10	heteroecious/dioecious	tetraploid
<i>F. pentaphylla</i>	3	hermaphroditic*	diploid
<i>F. tibetica</i>	4	heteroecious/dioecious	tetraploid
<i>F. vesca</i>	137	hermaphroditic	diploid
<i>F. virginiana</i>	26	heteroecious/dioecious	octoploid
<i>F. viridis</i>	51	hermaphroditic*	diploid
<i>D. indica</i>	4	hermaphroditic	diploid and dodecaploid
<i>P. sterilis</i>	2	hermaphroditic	diploid
Total	519 accessions		

* self incompatible

**pentaploid, hexaploid, and enneaploid members of this hybrid species are described (Staudt, 1999)

Plant Maintenance

Core Collection

The species of the living plant collection is comprised of 519 accessions of the approximately 24 species and natural hybrids of *Fragaria* (Tab. 1). Currently, 48 artificial hybrids between species are maintained as well. Accessions with at least four plants per pot are cultivated in clay pots (20 cm diameter) with one duplicate of each as a core collection. The plants are deposited in a frost-free glasshouse during winter and are established outside from May until October at the company's location in Dresden-Weixdorf, Germany (elevation 188 m above mean sea level, latitude: 51.142703°, longitude: 13.772751°). Inflorescences are removed after fruit set and evaluation of first fruits to avoid outcrossing or self-pollination of the core collection and contamination of the true type collection by seedlings. Therefore, a working collection directed to specific breeding work and research is used.



Core collection Hansabred during winter (A) and summer (B) cultivation

Working Collection

Propagation from the core collection is used for specific research projects. Pot plants or outside plantations of 1m² each are used for breeding and research as follows:

- cross-breeding within the Hansabred breeding program (Ludwig et al., 2013),
- *Verticillium* resistance tests (in cooperation with the University of Applied Sciences Dresden, Germany),
- inoculation tests with *Drosophila suzuki* (in cooperation with the Ludwig Maximilian University Munich, Germany),
- fruit diversity studies, i.e. metabolites (in cooperation with the Julius Kühn-Institute, Institute for Ecological Chemistry Plant Analysis and Stored Product Protection, Quedlinburg and Berlin-Dahlem, Germany; Ulrich and Olbricht, 2013),
- resistance evaluation to spider mite (in cooperation with Technische Universität Dresden and the Julius Kühn-Institute, Institute for Ecological Chemistry Plant Analysis and Stored Product Protection, Quedlinburg, Germany, funded by the German Federal Ministry of Education and Research (BMBF, FKZ 031A216A/B)),
- analysis of the wax chemistry of leaf surfaces in the genus and implementations for biotic and abiotic stress (in cooperation with the Universität Würzburg, Germany in the frame of BMBF, FKZ 031A216A/B; Wagner et al., 2015),
- taxonomical evaluation (in cooperation with Technische Universität Dresden, Institute of Botany, Germany; Staudt and Olbricht, 2008; Olbricht, 2012),
- evaluation of field resistances, e.g. fungal diseases, at Hansabred,
- collection and description of indigenous *Fragaria* species (in cooperation with the Senckenberg Museum für Naturkunde, Görlitz, Germany),
- mutation breeding using biotechnological methods for adapting low ploidy forms (species and species hybrids) to higher chromosome levels and further use in breeding (in cooperation with Humboldt-Universität zu Berlin, Faculty of Life Sciences, Albrecht Daniel Thaer-Institute of Agricultural and Horticultural Sciences, Germany; Pinker et al., 2012),
- molecular studies (in cooperation with the Instituto Andaluz de Investigación y Formación Agraria y Pesquera (IFAPA), Málaga, Spain and with the Research Institute of Horticulture, Skierniewice, Poland),
- taxonomical studies and exchange of accessions (in cooperation with USDA ARS National Clonal Germplasm Repository 33447 Peoria Road, Corvallis, Oregon, USA; College of Horticulture, Shenyang Agricultural University Shenyang, Liaoning, China; INRA, Bordeaux, France; the Botanic Garden and Botanical Museum Berlin-Dahlem, Freie Universität Berlin, Germany; Department of Agricultural Sciences, University of Helsinki, Finland).



Working collection: 1m² planted in the open ground for fruit analysis (VOC analysis) and resistance evaluation



F. chiloensis ssp. *chiloensis* forma *patagonica*, Villarica, Chile

Taxonomical work

The Herbarium and taxonomical issues

Staudt classified 24 species of *Fragaria* including three nothospecies. Their taxonomy and phylogeny based on chromosome numbers, branching of stolons, crossing experiments, sex expression, pollen morphology and geographic distribution. Günter Staudt was involved in strawberry research ranging from molecular and cytological studies to extensive breeding programmes in the US, France and Germany. Günter Staudt's most valuable herbarium specimens are now kept in the herbarium of the Botanical Museum Berlin-Dahlem, Germany. The herbarium of 1705 sheets was digitized and a first classification was done. Among the 260 accessions of the germplasm species collection of Hansabred, 37 accessions of the herbarium are maintained (Olbricht et al., 2014). Since Staudt's revision of the genus (Staudt, 2009) one newly discovered species has to be added: Hummer (2012) described *Fragaria cascadenis* K. E. Hummer spec. nov. with its habitat in the Cascade Mountains in Oregon, USA, as the second decaploid species in the genus. Additionally, a newly collected accession of *F. iturupensis* Staudt was determined as decaploid (Hummer et al., 2009.) in contrast to the cytogenetic investigation of the original species description by Staudt (1973). Because the original accession is lost it is suggested to mention both results due to the scientific history of the species description. *Fragaria nilgerrensis* ssp. *hyatai* was allocated by Staudt as a subspecies to *F. nilgerrensis* (Staudt, 1999). In his review (2009) he separated this subspecies and listed *F. hyatai* as a species due to results of the pollen surface investigation which differed from *F. nilgerrensis*. Whether or not this separation should be retained depends on further studies of the subspecies of *F. nilgerrensis* and the availability of plant material from Taiwan. Depending on this, we can describe 24 or 25 species of the genus *Fragaria* including three nothospecies.

In particular the Asian Species growing in habitats of an important genetic diversity centre of *Fragaria* need further collections and scientific investigations.



Herbarium specimen, *Fragaria iturupensis* Staudt, Typus, digitized at the Botanical Museum Berlin-Dahlem, Röpert, D. (Ed.) 2000- (continuously updated): Digital specimen images at the Herbarium Berolinsense. Published on the Internet <http://nwb2.bgbm.org/herbarium/> (Barcode: B 10 0295747 / ImageId: 296476)

