

CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

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*Revision of taxonomic classification and nomenclature of
living plant accessions in the collection of Botanical
Garden of the Faculty of Tropical AgriSciences, CULS
Prague*

Bachelor Thesis

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Abstract

The Botanical garden of Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, is specialised on useful tropical and subtropical plant. Complete catalogization of all taxa were done in 2008, but was necessary to revised taxa through current nomenclature and taxonomical standards. By this thesis comes out tables of plants with families (divided based on greenhouses) which were revised. Found mistakes were adequately corrected and the corrections are recommended for collection management system of Botanical garden. Newly created tables of each greenhouse, contain synonyms of plants which could facilitate future work with the collection.

Key words:

Botanical garden, plant taxonomy, APG classification, botanical nomenclature, taxonomic revision, nomenclature revision

Abstrakt

Botanická zahrada Fakulty tropického zemědělství, při České Zemědělské Univerzitě v Praze, se specializuje na užitkové rostliny tropů a subtropů. Kompletní katalogizace všech taxonů byla provedena v roce 2008, ale bylo nezbytné provést revizi taxonů za pomoci současných nomenklatorických a taxonomických standardů. Touto bakalářskou prací byly vytvořeny tabulky rostlin s čeleděmi (rozdělené podle skleníků), které byly zrevidovány. Nalezené nepřesnosti byly adekvátně opraveny a opravy jsou doporučeny pro management rostlinné sbírky v botanické zahradě. Nově vytvořené tabulky každého skleníku obsahují synonyma rostlin, které mohou usnadnit budoucí práci se sbírkou.

Klíčová slova:

Botanická zahrada, rostlinná taxonomie, APG klasifikace, botanická nomenklatura, taxonomická revize, nomenklatorická revize

Certification

I, Anna Chládová, declare that this thesis, submitted in partial fulfilment of requirements for the bachelor degree, at the Faculty of Tropical AgriSciences of the Czech University of Life Sciences Prague, is wholly my own work unless otherwise referenced or acknowledged.

In Prague, 25.4. 2013

Anna Chládová

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List of Tables

Table 1. Ranks and endings of taxa.....	10
Table 2. Eight exceptions of families with two names.....	11
Table 3. Examples of families in which have been observed changes based on APG classification.....	13
Table 4. Table of Credibility.....	16
Table 5. Families which have been changes in Subtropical greenhouse.....	17
Table 6. Families which have been changes based on APG in Tropical greenhouse.....	18
Table 7. Plants identified on genus level in the Tropical greenhouse. Plants identified on species level but untrustworthy in the Tropical greenhouse.....	19
Table 8. Families which have been changes based on APG in Table greenhouse.....	21
Table 9. Plants identified only on genus level in the Table greenhouse.....	22
Table 10. Plants from Table greenhouse which had wrong designation of authors in previous list of plants and adequate revision of authors' names is showing following table.	23
Table 11. Families which have been changes based on APG in Outdoor collection.....	25
Table 12. Plant synonyms which been previously mentioned as accepted names in Outdoor collection.....	25
Table 13. Small ambiguity with plant names were found by revision and corrected in Outdoor collection.....	26

Table of Content

1. Introduction.....	1
2. Objectives	2
3. Methodology.....	3
4. Study Background.....	5
4.1. Principles of Taxonomy	5
4.1.1. Taxonomy and Systematic	5
4.1.2. Approaches to biological classification.....	6
4.2. The International Code of Botanical Nomenclature - Vienna Code	7
4.2.1. History of ICBN	7
4.2.2. Names of Taxa.....	8
4.3. Families classification based on The Angiosperm Phylogeny Group	11
4.4. Databases used for nomenclatural and taxonomical revision	13
4.4.1. Botanical database: Tropicos.....	13
4.4.2. Botanical database: The Plant list (PL)	13
4.4.3. Other used databases	14
5. Results.....	15
5.1. Subtropical greenhouse	16
5.2. Tropical greenhouse	17
5.3. Table greenhouse	20
5.4. Outdoor collection.....	23
5.5. Lysimetric greenhouse	25
6. Discussion.....	27
7. Conclusion	29
References.....	30
Appendix.....	33

1. Introduction

There are Botanical gardens and Arboretums in 148 countries worldwide and they maintain more than 4 million living plant collections. In current times, the role of Botanic gardens is conservation of plants and education of the people. According to Global Strategy for Plant Conservation (GSPC) have Botanic gardens following functions: "...They provide knowledge and expertise in plant taxonomy, horticulture, biodiversity inventory, conservation biology, restoration ecology and ethnobotany..." (BGCI, 2005). Botanical Garden of Faculty of Tropical AgriSciences (FTA), CULS Prague was established as a specialized collection of useful plants from Tropical and Subtropical regions. That makes this garden unique in the Czech Republic. Collection of BG is intended primarily for the education of students, for scientific researches and for growing and research new kinds of crops imported by the workers from abroad.

After the cataloguing of plant collection of FTA in 2008 was necessary revision of all plants and families according to actual taxonomical and nomenclature standards. These standards are provide by APG classification, taxonomic databases and International Code of Botanical Nomenclature (ICBN). With the aid of this thesis come out list of all taxa (from Subtropical greenhouse, Tropical greenhouse, Table greenhouse, Lysimetric greenhouse and Outdoor collection) which were subjected to revision; this list should be applied by Botanical garden in future work with collection.

The plants in the botanical gardens should be correctly identified and documented. Documentation nowadays can be done by database software, which organized data in a well arranged way and enable fast access. (Leadlay et al., 1998). Also Botanical garden of FTA should records every living specimen to the database software. By documenting of collection makes her more available, easily accessible and sustainable for the future. These times there is no comprehensive documentation about the plants which are located in the collection. This thesis will contribute to the documentation of plants by providing a complete list of plants which were subjected to taxonomical and nomenclatural revision and also by list of synonyms which was created.

2. Objectives

The objectives of this thesis were made revision of taxonomic classification and nomenclature of living plant accessions in the collection of Botanical Garden of the Faculty of Tropical AgriSciences, Czech University of Life Sciences in Prague by The International Code of Botanic Nomenclature and The Angiosperm Phylogeny Group classification and by databases on the internet: Tropicos, The Plant List, The International Plant Names Index, GRIN taxonomy, PROTA4U, Mansfeld's database.

The collection of Botanic Garden of FTA, CULS Prague is not relevant with regard to processing correct taxonomic classification. Taxonomic revision was necessary due to future work with plant collection by researchers and students. In future also makes a next step for botanic garden by recording correct names to cataloguing software.

3. Methodology

First step was adumbrate information about taxonomy, rules of using botanical names by International Code of Botanical Nomenclature (ICBN), APG classification and find out credible plant databases. For this purpose were used scientific articles and books, but mainly official website of ICBN, APG, and databases. All sources are listed in the references.

Secondly, despite previous list of plants created by Duchoň, (2008), it was necessary to do inventorization of the greenhouses because since last list of plants, some changes in Botanical garden were done: adding / removing of plants. Afterwards the list of plant was ready for revision. The final table was made by Microsoft Office Excel 2007; is divided into tabs. First tab contain short description for using of table, other tabs correspond with greenhouses. Plant table of greenhouses contain columns: family, scientific name of plants, synonyms and credibility. Verification of families, genera and species was done primarily by APG and databases **Tropicos**, **The Plant List**, **GRIN Taxonomy for Plants**, **The Mansfeld's World Database of Agriculture and Horticultural Crops**, **International Plant Name Index (IPNI)**, **PROTA4U** (Plant Resources of Tropical Africa). Trustworthiness of revision is supported by column credibility. Tropicos was chosen as the initial sources for taxonomic and nomenclatural revision. It is the most comprehensive botanical database with aim to accumulate all plant species in the world. Data are collected mostly from floristic projects throughout the world and stored on Tropicos, which is constantly updated (Missouri Botanical Garden, 2013). The Plant List was second the most widely used on-line database. Its benefit is that showing actual status of each plant and presenting families based on APG. Statuses are: Accepted Name, Synonym, Unresolved Name, and Misapplied Names. Also can happen that plant is determined as "Invalid Name", "Illegitimate Name" or with "Spelling variants" (or "Orthographic variants") by The Plant List; and in this case it is mentioned behind the name of plant in parenthesis. Mansfeld's Database and GRIN taxonomy are databases which focus on agricultural and horticultural crops; were used because our Botanical garden is also oriented to this type of crops. International Plant Name Index (IPNI) is additional database for this thesis. IPNI is not update as frequently as database mentioned above and doesn't show clear sheet of plant synonyms. PROTA4U (Plant Resources of Tropical Africa) it is database specialised for African plants and for this thesis was used mainly for creating of list of synonyms.

Synonyms of each plant were also found in databases. In this case were used Tropicos, The Plant List, PROTA4U, GRIN taxonomy and Mansfeld's database. For purpose of this thesis, were selected synonyms which are matched at least in two databases. Verification of synonyms was done by numbers of publication where are mentioned (in Tropicos and PROTA4U, Mansfeld's) and in The Plant List by stars rating; 3 stars mean credible, 2 stars less credible and 1 star the least credible, in some cases were written behind name of synonym "Invalid" or "Illegitimate" and for this thesis was not taken as suitable.

4. Study Background

4.1. Principles of Taxonomy

4.1.1. Taxonomy and Systematic

Science about classification of organisms is called taxonomy. Most of the scientists, especially in west countries, consider systematic botany and plant taxonomy as synonyms. (Zelený, 2004). Nevertheless some authors distinguish systematic and taxonomy as two terms (Schuh, 2000). Stevens (1994) attempted to clarify the distinction between taxonomy and systematics, offered this definition of systematics: “the scientific study of the kinds and diversity of organisms and any and all relationships among them.” and taxonomy explicate by using classification. He said that classification is the grouping of organisms into the hierarchy of a classification; taxonomy is the theoretical study of classification. Wilkins (2003) cites in his doctoral dissertation Ornduff (1969) “Systematic and taxonomy are almost, but not quite, the same thing. The usual definition is:

Taxonomy: classification of taxa (units of classification) in a system that expresses their relationships

Systematics: comparative studies of a systematic unit (i.e., a group of organisms or species and higher), the fact-finding field of taxonomy”

In Plant systematic (Simpson, 2006) is written, that taxonomy is a major part of systematic and includes four components: description, identification, nomenclature and classification of plants. Taxa or taxon is base word for taxonomy, which delimit group of organism.

The relevance of systematic is obvious. Emphasizing relevance of Systematic by Stuessy (2009): “Systematic is truly fundamental for satisfying our intellectual curiosity about the nature of the World in which we live, formulating principles and methods of classification applicable to many human needs and activities, helping preserve the world’s organic diversity for aesthetic and economic reason, and more directly in developing economic potentials.” Also Singh (2004) express his opinion about importance of systematic, he maintained that plant systematic is base for other biological sciences, but in turn other biological sciences can be useful for construction of classification.

4.1.2. Approaches to biological classification

The last 50 years two relatively new approaches have been evolved: Phenetic and cladistic. Lay stress on quantitative and more objective classification, within the meaning that classification of plants is working with more data from different sciences as genetic, phyletic, numerical formulas etc. (Stuessy, 2009)

In this time recognizing tree main approaches in plant taxonomy: phyletic, phenetic, cladistic approach. Whereas of developing of genetic, now the most used approach is cladistic. Reason is simple: cladistic combines phylogenetic dates, morphology dates and molecular dates.

Since the book of Charles Darwin (*On the Origin of Species by Means of Natural Selection, 1859*) was published phyletic approaches was accepted (Stuessy, 2009).

The Phyletic Approaches maximize evolutionary interpretations during the natural classification, it means that focus on phylogenetic relation of organisms on base of homology and analogy (Mártonfi, 2006). But for some taxonomists was a phyletic approach too subjective. For this reason, around 1960s, new approach was implemented; **The Phenetic Approach** is basically numerical classification. Possible is labelled the Phenetic as statistical taxonomy, mathematical taxonomy or quantitative taxonomy. Phenetic is defined as a method of classification based on numerous precisely delimited characters (with carefully coded states) usually of equal weight and their comparison by an explicit method of grouping (Stevens 2000a; Stuessy 2006). The Phenetic is better use for lower levels of hierarchy (specific and intraspecific). Because enormous benefit of cladistic and phenetic is that it used large amounts of data. For familial level and levels above results can be misrepresented. **The Cladistic Approach** is determined by “branching pattern of evolution” (Stuessy, 2006). Evaluation phylogenetic affinity of plants on base morphology dates and molecular dates. A summary of a large number of partial results cladistic analyses was introduced by group of botanists called Angiosperm Phylogeny Group (APG). They published in 1998 at journal *Annals of the Missouri Botanical Garden* new system, just based on cladistic analyses. In 2003 at *Botanical Journal of Linnean Society* was published update version, called APG II (Mártonfi, 2006).

4.2. The International Code of Botanical Nomenclature - Vienna Code

The International Code of Botanical Nomenclature (ICBN) is established standards for nomenclature of plants. Main goal of ICBN is provide one correct name for each taxonomic group (or taxon) within a stable system of names. Last standards were accepted on XVII. International Botanical Congress in Vienna, in 2005. Botanical Code is book which reminiscent juristic literature (Mártonfi, 2006). The International Code of Botanical Nomenclature (Vienna Code) is published by the International Association of Plant Taxonomy (IAPT).

Binomial nomenclature under which the name of species consists of two parts, the first name of the genus to which it belongs and the second the specific epithet (Singh, 2004). First letter of genus is capital letter, species has all letters small. After name of the plant is written name of author/s (as abbreviation) who described and designated the plant. Scientific names of taxonomic groups are treated as Latin (written by italic type) (IAPT, 2012).

4.2.1. History of ICBN

“Biology requires a precise and simple system of nomenclature that is used in all countries...” (IAPT, 2012). Therefore plants had more than one name or names were too long, for example species willow was called: *Salix pumila angustifolia altera*. Casper Bauhin in 1623 came up with binomial nomenclature. It means that plant has just two names: first the name of genus and second the specific epithet, but he did not mention with all species, that's way is binomial nomenclature attribute to Linnaeus who published it in his work *Species plantarum* (1737). Linnaeus was made the starting point for plant nomenclature and the rule of priority was made fundamental. (Singh, 2004)

First International Botanical Congress at Paris was held in 1867. “Second Congress in Vienna (1905) accepted the first internationally developed rules governing the naming of plants, *Règles internationales de la Nomenclature botanique adoptées par le Congrès International de Botanique de Vienne 1905 / International rules of Botanical Nomenclature ... / Internationale Regeln der Botanischen Nomenclatur ...* – or simply the *Vienna Rules*” (IAPT, 2006). Generally the goals of Botanical congresses are established rules about unanimous nomenclature of plants. Since the first congress, were already realized 17 additional which updated The ICBN.

During writing of this thesis XVIII International Botanical Congress in Melbourne, Australia in July 2011 was held and afterwards output was published in 2013 with significant changes. The official name was transform to International Code of Nomenclature for algae, fungi, and plants (Melbourne Code). That happened because word “Botanical” in previous code was misleading and could mean that the Code include only green plants and doesn’t count with fungi and algae.

4.2.2. Names of Taxa

Based on ICBN (IAPT, 2012): “The principal ranks of taxa in descending sequence are: kingdom (*regnum*), division or phylum (*divisio*, *phylum*), class (*classis*), order (*ordo*), family (*familia*), genus (*genus*), and species (*species*). Thus, each species is assignable to a genus, each genus to a family, etc.” For better notion, example is shown on *Mangifera indica* (USDA, 2013):

Kingdom: *Plantae*
Subkingdom: *Tracheobionta*
Superdivision: *Spermatophyta*
Division: *Magnoliophyta*
Class: *Magnoliopsida*
Subclass: *Rosidae*
Order: *Sapindales*
Family: *Anacardiaceae*
Genus: *Mangifera* L.
Species: *Mangifera indica* L.

The secondary ranks of taxa in descending sequence are tribe (*tribus*) between family and genus, section (*sectio*) and series (*series*) between genus and species, and variety (*varietas*) and form (*forma*) below species. (IAPT, 2012)

“If a greater number of ranks of taxa is desired, the terms for these are made by adding the prefix "sub-" to the terms denoting the principal or secondary ranks. A plant may thus be assigned to taxa of the following ranks (in descending sequence): *regnum*, *subregnum*, *divisio* or *phylum*, *subdivisio* or *subphylum*, *classis*, *subclassis*, *ordo*, *subordo*, *familia*, *subfamilia*, *tribus*, *subtribus*, *genus*, *subgenus*, *sectio*, *subsectio*, *series*, *subseries*, *species*, *subspecies*, *varietas*, *subvarietas*, *forma*, *subforma*.” (IAPT, 2012)

Table 1. Ranks and endings of taxa.

Rank		Ending	Example
Kingdom			<i>Plantae</i>
	Subregnum	<i>-bionta</i>	<i>Cormobionta</i>
Division		<i>-phyta</i>	<i>Magnoliophyta</i>
	Subdivision	<i>-mycota (Fungi)</i>	<i>Eumycota</i>
		<i>-phytina</i>	<i>Pterophytina</i>
		<i>-mycotina (Fungi)</i>	<i>Eumycotina</i>
Class		<i>-opsida</i>	<i>Magnoliopsida</i>
	Subclass	<i>-phyceae (Algae)</i>	<i>Chlorophyceae</i>
		<i>-mycetes (Fungi)</i>	<i>Basidiomycetes</i>
		<i>-opsidae</i>	<i>Pteropsidae</i>
		<i>-idae (Seed plants)</i>	<i>Rosidae</i>
		<i>-physidae (Algae)</i>	<i>Cyanophysidae</i>
		<i>-mycetidae (Fungi)</i>	<i>Basidiomycetidae</i>
Order		<i>-ales</i>	<i>Rosales</i>
	Suborder	<i>-ineae</i>	<i>Rosineae</i>
Family		<i>-aceae</i>	<i>Rosaceae</i>
	Subfamily	<i>-aideae</i>	<i>Rosoideae</i>
	Tribe	<i>-eae</i>	<i>Roseae</i>
	Subtribe	<i>-inae</i>	<i>Rosinae</i>
Genus		<i>-us, -um, -is, -a, -on</i>	<i>Pyrus, Allium, Arabis, Rosa,</i>
	Subgenus		<i>Cuscuta subgenus Eucuscuta</i>
	Section		<i>Scrophularia section Anastomosanthes</i>
	Subsection		<i>Scrophularia subsection Vernales</i>
	Series		<i>Scrophularia series Lateriflorae</i>
	Subseries		
Species			<i>Rosa canina</i>
	Subspecies		<i>Crepis sancta</i> subsp. <i>bifida</i>
	Varietas		<i>Lantana camara</i> var. <i>varia</i>
	Subvarietas		
	Forma		<i>Tectona grandis</i> f. <i>punctata</i>
	Subforma		

First column showing the principal ranks of taxa and the secondary ranks of taxa. Second column showing latin ending of taxa and the examples are demonstrate at third column; Based on Singh (2004) and ICBN (2006)

Table 2. Eight exceptions of families with two names.

Traditional name	Original name	Type genus
<i>Cruciferae</i>	<i>Brassicaceae</i>	<i>Brassica</i>
<i>Guttiferae</i>	<i>Clusiaceae</i>	<i>Clusia</i>
<i>Leguminosae</i>	<i>Fabaceae</i>	<i>Faba</i>
<i>Umbelliferae</i>	<i>Apiaceae</i>	<i>Apium</i>
<i>Compositae</i>	<i>Asteraceae</i>	<i>Aster</i>
<i>Labiatae</i>	<i>Lamiaceae</i>	<i>Lamium</i>
<i>Palmae</i>	<i>Arecaceae</i>	<i>Areca</i>
<i>Gramineae</i>	<i>Poaceae</i>	<i>Poa</i>

There are eight families whose original names not correspond with the rules of ICBN but these names have traditional usage and were accepted two names for each family (Singh, 2004).

At the present times, opinions of usage subspecies and variety differ. “Some workers use only subspecies to describe initial patterns of intraspecific variation, others use only varieties, and still others use both categories.” (Stuessy, 2009). Here are simplified differences between taxa below the rank of species based on Botanika I. (Zelený, 1982) and advice by this author. **Subspecies** is possible defined as taxon with own morphological and other characteristics and distribution which is diverse from other subspecies of species. For nomenclature purpose is use abbreviations subsp. or ssp. In contrast with varietas is determined area of distribution. Examples: *Montia parvifolia* subsp. *parvifolia*, *Montia parvifolia* subsp. *Flagellaris*. Taxon **varietas** has weakly hereditary morphological characteristics that are caused by habitat factors. Areal of distribution is not determined. Abbreviation var. belongs to varietas. Example: *Lobelia spicata* Lam. var. *spicata*. **Forma** is the lowest taxon. We can talk about forma when small genetic changes as a result of mutation/recombination are expressed a few stable morphological changes like shape of leaves, colour of flowers, etc. The forma plant is not much different from total genetic composition of the normal species; these two taxa differ only in one feature. Example: *Hypericum humifusum* L. f. *liottardii*.

Cultivar is special categories of plants used in agriculture, forestry, and horticulture (and arising either in nature or cultivation). In on-line version of ICBN is written about cultivar “Organisms brought from the wild into cultivation retain the names that are applied to them when growing in nature.” (IAPT, 2012). Nomenclature of cultivated plants was in the past nonuniform and sometimes even muddle was appeared. That’s why in second half of 20th century was established the International Code of Nomenclature for Cultivated Plants (ICNCP). Example of right using of cultivar name: *Iris* ‘Cantab’ or *Iris* 'Cantab', it is not

allowed use *Iris* “Cantab” or *Iris* cv. Cantab or *Iris* var. Cantab; another right example *Pinus sylvestris* ‘Repens’ (Brickell, 2009).

4.3. Families classification based on The Angiosperm Phylogeny Group

The Angiosperm Phylogeny Group (APG) is a group of systematic botanists which have worked on new classification of the seed plants, focus on orders and families. APG classification is mainly based on phylogeny (define as the evolutionary history of an organism or group of organisms-definition on Angiosperm Phylogeny Website). On Angiosperm Phylogeny Website is mentioned “Only with a phylogeny can we begin to understand diversification, regularities in patterns of evolution, or simply suggest individual evolutionary changes within a clade.” (Stevens, 2001)

APG II (2003) said that new knowledge of phylogeny revealed relationships in conflict with the then widely used modern classifications by Cronquist, 1981; Thorne, 1992; Takhtajan,1997, which were based more on morphology than more accurate cladistic anylysis. Older classification also did not reflected phylogenetic relationships of flowering plants; for solving this problem was established a group of flowering plant systematists, calling themselves the Angiosperm Phylogeny Group (APG for short), proposed a new classification for the families of flowering plants (APG, 1998).

In APG (1998) was presented a classification of 462 flowering plant families in 40 supposed monophyletic orders and a small number of monophyletic, informal higher groups (the monocots, commelinoids, eudicots, core eudicots, rosids including eurosids I and II, and asteroids including euasterids I and II). There was also listed a number of families without assignment to order.

"Higher-level classifications, the grouping of species into families, orders, etc. , are needed as reference tools not only in systematic but also in many other branches of biology." cited from (APG, 1998). Also was said, that phylogeny is becoming more important and imperative as reference tool. Nevertheless APG classification is not in status complete and formal classification of angiosperms, still leaving many major nodes unnamed or giving these only informal names (magnoliids, monocots, lamiids, etc.). (Chase & Reveal, 2009). The APG accept strictly just monophyletic groups at all levels, but it still exist families known to be non-monophyletic (APG II, 2003).

For purpose of this bachelor thesis APG classification was applied for verification of families in Botanic Garden of FTA CULS Prague. Checking of families was done by list of families on official website of APG and also by Chart of flowering plant families. The Chart simplified website, make clearer outline of classification and phylogeny, provide basic characterization of families with the most representative plants from each family.

Table 3. Examples of families in which have been observed changes based on APG classification.

Previous Families	Families according to APG
<i>Agavaceae</i>	<i>Asparagaceae</i>
<i>Alpinaceae</i>	<i>Zingiberaceae</i>
<i>Averrhoaceae</i>	<i>Oxalidaceae</i>
<i>Bambusaceae</i>	<i>Poaceae</i>
<i>Bombacaceae</i>	<i>Malvaceae</i>
<i>Coffeaceae</i>	<i>Rubiaceae</i>
<i>Crinaceae</i>	<i>Amaryllidaceae</i>
<i>Dracaenaceae</i>	<i>Asparagaceae</i>
<i>Garciniaceae</i>	<i>Clusiaceae</i>
<i>Hederaceae</i>	<i>Araliaceae</i>
<i>Oryzaceae</i>	<i>Poaceae</i>
<i>Papayaceae</i>	<i>Caricaceae</i>
<i>Papyraceae</i>	<i>Cyperaceae</i>
<i>Paulliniaceae</i>	<i>Sapindaceae</i>
<i>Pistaciaceae</i>	<i>Anacardiaceae</i>
<i>Saccharaceae</i>	<i>Poaceae</i>
<i>Sansevieriaceae</i>	<i>Asparagaceae</i>
<i>Sterculiaceae</i>	<i>Malvaceae</i>
<i>Tradescantiaceae</i>	<i>Commelinaceae</i>
<i>Diospyraceae</i>	<i>Ebenaceae</i>
<i>Ficaceae</i>	<i>Moraceae</i>
<i>Melaleucaceae</i>	<i>Myrtaceae</i>
<i>Papyraceae</i>	<i>Cyperaceae</i>
<i>Phormiaceae</i>	<i>Xanthorrhoeaceae</i>
<i>Pistaciaceae</i>	<i>Anacardiaceae</i>
<i>Punicaceae</i>	<i>Lythraceae</i>
<i>Yuccaceae</i>	<i>Asparagaceae</i>

On the left side previous designation of families, and on the right side is valid name of families according to APG. As an example is describe first row: previously was *Agavaceae* separate family, but APG established *Asparagaceae* as accepted family and *Agavaceae* was become a subfamily *Agavoideae* (Nyffeler and Eggli, 2010).

4.4. Databases used for nomenclatural and taxonomical revision

For purpose of this thesis was chosen freely available online databases. The most required were Tropicos, The Plant List, IPNI, PROTA4U, GRIN Taxonomy, Mansfeld's database. Here are providing brief overview about them.

4.4.1. Botanical database: Tropicos

For purpose of this thesis was Tropicos chosen as one of the main sources for taxonomic and nomenclatural revision. Tropicos is the most comprehensive botanical database provided by Missouri Botanical Garden with contents of more than 1.2 million scientific names, 660,000 synonyms and 179,000 plant images. The main aim of Tropicos is accumulate all plant species in the world. Data for Tropicos are mainly collected by large floristic projects as Flora of North America, Flora of China and Flora Mesoamericana, etc. and other floristic institutions. (Missouri Botanical Garden, 2013).

Relevance of right plant selection was done by confidence level which is given by following symbols: ! = Legitimate, * = Illegitimate, ** = Invalid, *** = nom. rej. (nomen rejiciendum=name rejected), !! = nom. cons. (nomen conservandum). For thesis was selected plant without star symbol because it is not suitable, and take into account the exclamation symbol.

As a big helper for Tropicos showed to be a project Botanicus which digitized large number of scientific literature from the Missouri Botanical Garden Library. Botanicus website is not helpful just for Tropicos but for wide range scientists for facilitate of their work. (Royal Botanic Gardens, Kew, 2013).

4.4.2. Botanical database: The Plant list (PL)

All describe species of plants, include Vascular plant (flowering plants, conifers, ferns) and Bryophytes are listed in The Plant List. Algae or fungi are not covered by Plant List. Purpose of formation PL was reaction to the Global Strategy for Plant Conservation; the main goal was to create: "a widely accessible working list of all known plant species, as a step towards a complete world Flora" (The Plant List, 2010). PL contain 1 244 871 scientific plant names. Benefit of PL is that showing actual status of each plant and presenting families based on APG. Statuses are: Accepted Name, Synonym, Unresolved Name, and Misapplied Names. Also can happen that plant is determined as "Invalid Name", "Illegitimate Name" or with "Spelling variants" (or "Orthographic variants") by The Plant List; and in this case it is mentioned behind the name of plant in parenthesis.

System of “Confidence Levels” is provided in PL; ensure correctness of the plant name. The Plant List (2010) says that: "...based primarily on the nature and taxonomic integrity of the source data." Star symbol is giving confidence level. Here is shown excerpt from PL.

- ★★★★ High Confidence level
- ★★★ Medium Confidence level
- ★ Low Confidence level

Data resources which were used for creation of PL are divided into 3 parts: Global species resources, Floristic Datasets, Plant nomenclatural resources.

4.4.3. Other used databases

GRIN taxonomy for plants and Mansfeld’s database: World Database of Agricultural and Horticultural Crops are other well-know databases contain correct scientific name and synonyms. These databases focus on agricultural and horticultural crops.

“The International Plant Names Index (IPNI) is a database of the names and associated basic bibliographical details of seed plants, ferns and lycophytes.” (IPNI, 2012). IPNI is made by The Royal Botanic Gardens (Kew), The Harvard University Herbaria, and the Australian National Herbarium. IPNI was applying mainly with unclarities of scientific names.

PROTA (Plant Resources of Tropical Africa) is a programme which process useful plants of Tropical Africa, make well-arranged database of plants called PROTA4U; contains detailed information of each plant, but for my purpose was taken as objective data correct scientific name and list of synonyms. Advantage of synonyms from PROTA4U it that refer links where were synonyms search. That was important point during revision and making of list synonyms for plant in Botanical Garden of Faculty of Tropical AgriSciences.

5. Results

The final tables of revised plants from greenhouses were made by Microsoft Office Excel 2007; are divided into tabs. First tab contain short description for using of table, other tabs correspond with greenhouses. Plant table of greenhouses contain columns: family, scientific name of plants, synonyms and credibility. The tables of revised taxa and the tables of recommended changes are recorded on attached CD. However for better notion see appendix where is shown example how tables looks like.

Results of each greenhouse (GH) are presented separately. First will be shown Subtropical GH followed by Tropical GH, Table GH, Outdoor Collection and Lysimetric GH. Scheme of results is ensuing; Firstly is short introduction, where are general information which been ascertained as total number of plants, the most represented families, and physically added or removed plants. Secondly are stated changes in families. It was done because some plants were previously incorrectly classified or taxonomy was change since last list of plants in Botanical garden.

Results of revised plants are enumerated according to table of credibility, from 1 to 4, see Table 4. Number 1 belongs to plants with verify family, genus and species. Number 2 is for plants with verify family and genus, the species is not identified or plants are untrustworthy identified on species level. Number 3 have plants where some small ambiguity was appeared; it means author's name(s) or mistake of the scientific name in previous list. Designation 3a belong synonyms which were by previous list detected as accepted scientific name. Number 4 was added to plant, in which databases differ and is not sure correctness. "N" was assigned to plants, which were newly added to the list.

Table 4. Table of Credibility.

Symbol	Description of symbol
1	Verified family, genus, species (based on previous designation and based on verify in databases)
2	Verified family, genus; the species is not identified or plants are untrustworthy identified on species level.
3	Small ambiguity: mainly with authors, mistake of name, etc.
3a	Synonym was written as scientific name in previous list.
4	Data differ, not sure with correctness
N	Newly added plants, verify in databases

5.1. Subtropical greenhouse

Subtropical greenhouse belongs to collection with lowest number of plants. Total number of plants is 35. Nearly one half of the area is covered by genus *Citrus* therefore the highest numbers of plants are classified into family *Rutaceae*. The second most represented family is *Myrtaceae*; other families are included one maximum two plants. Inventorization, which preceded revision, was updated list of plants; from collection was removed *Pelargonium odoratissimum* (L.) L'Hér. and were added *Cyperus* sp., *Nephrolepis exaltata* (L.) Schott, *Myrtus communis* L., *Psidium littorale* Raddi, *Psidium guineense* Sw., *Melaleuca alternifolia* Cheel, *Pistacia vera* L. Subsequent revision detected several imperfections with families, small ambiguity (author's names, mistakes in name of plants etc.), and designation of species. **The table of revised plants and the table of recommended changes for Subtropical greenhouse are recorded on attached CD.**

In Subtropical greenhouse was found that 4 plants belonged previously to wrong family. That happened because classification was changed based on APG. Only with one family *Cappardiaceae* was typing error and correct family is *Capparaceae*.

Tabel 5. Families which have been changes in Subtropical greenhouse.

Plant name	Previous family	Revised family
<i>Yucca</i> L.	<i>Agavaceae</i>	<i>Asparagaceae</i>
<i>Capparis spinosa</i> L.	<i>Cappardiaceae</i>	<i>Capparaceae</i>
<i>Punica granatum</i> L.	<i>Punicaceae</i>	<i>Lythraceae</i>
<i>Phormium tenax</i> J.R. Forst. & G. Forst.	<i>Liliaceae</i>	<i>Xanthorrhoeaceae</i>

28 plants from collection of Subtropical greenhouse had no nomenclatural and taxonomical mistake. There are *Yuca* L. and *Cyperus* L. without designation of species. *Carica* × *pentagona* Heilborn was missing designation of hybrid; it is probably complex hybrid involving *Vasconcellea pubescens*, *V. weberbaueri*, and *V. stipulata*. (USDA, 2013). Databases Tropicos and IPNI designate *Psidium cattleianum* **Sabine** and database Plant list *Psidium cattleianum* **Afzel. ex Sabine**, it is small inaccuracy in species and name of author. Author name inaccuracy is also with *Melaleuca alternifolia* (**Maiden & Betche**) Cheel versus *Melaleuca alternifolia* Cheel.

The biggest problem was with family *Rutaceae*. It is known that genus *Citrus* has many species, cultivars and synonyms. That's why is sometimes correct designation impossible: many authors, who are interested in *Citrus*, have different opinions. Support of this

statement can find from Moore (2001): there is mentioned that for some authors all *Citrus* types belong to one large species and on the other hand Tanaka defined 147 different species of *Citrus* in 1954. Were found that *Citrus deliciosa* Ten., *Citrus unshiu* Marcow., *Citrus tangerina* Yu.Tanaka, were before on list separately but revision showed that all of them are synonyms of *Citrus reticulata* Blanco. Based on databases Tropicos and Faltýnek et al. (2005).

5.2. Tropical greenhouse

Tropical greenhouse (TG) is, along with Subtropical greenhouse, the most representative part of the Botanic garden. TG contains 129 plants. The highest number of plants is covered by family *Araceae* which include tuber crops and ornamental plants. Other most represented families are: *Zingiberaceae*, *Rubiaceae*, *Myrtaceae*, *Musaceae* and *Orchidaceae* with minimum 5 plants. 20 families have range from 2 to 4 plants and for 37 families belongs just one scientific name. Compared to previous list, were added 23 plants and remove 20 plants. **The table of revised plants and the table of recommended changes for Tropical greenhouse is recorded on attached CD.**

Following plants from Tropical GH were assigned to family which is not correct at present. Control was made by APG classification. Table is showing plant name, previous family name and newly revised family.

Tabel 6. Families which have been changes based on APG in Tropical greenhouse

Plant name	Previous family	Revised family
<i>Agave sisalana</i> Perrine ex Engelm.	<i>Agavaceae</i>	<i>Asparagaceae</i>
<i>Dracaena</i> Vand. ex L.	<i>Dracaenaceae</i>	<i>Asparagaceae</i>
<i>Ophiopogon jaburan</i> (Siebold) Lodd.	<i>Liliaceae</i>	<i>Asparagaceae</i>
<i>Sansevieria trifasciata</i> Prain	<i>Dracaenaceae</i>	<i>Asparagaceae</i>
<i>Calophyllum inophyllum</i> L.	<i>Clusiaceae</i>	<i>Calophyllaceae</i>
<i>Bombax</i> L.	<i>Bombacaceae</i>	<i>Malvaceae</i>
<i>Cola nitida</i> (Vent.) Schott & Endl	<i>Sterculiaceae</i>	<i>Malvaceae</i>
<i>Theobroma cacao</i> L.	<i>Sterculiaceae</i>	<i>Malvaceae</i>
<i>Nephrolepis exaltata</i> (L.) Schott	<i>Oleandraceae</i>	<i>Davalliaceae</i>
<i>Antidesma buniis</i> (L.) Spreng.	<i>Euphorbiaceae</i>	<i>Phyllanthaceae</i>
<i>Strelitzia reginae</i> Banks ex Aiton	<i>Sterculiaceae</i>	<i>Strelitziaceae</i>
<i>Flacourtia indica</i> (Burm. f.) Merr.	<i>Flacourtiaceae</i>	<i>Salicaceae</i>

From all plants of collection were 78 without any nomenclature mistake. To 28 were assigned symbol 2 from table of credibility. 21 plants are identified just on genus level but

these are mostly ornamental plants in the garden and for that reason it is not necessary to establish species to them, excluding *Bombax* and *Gossypium*. 7 plants are identified on species level but it is untrustworthy. To those belongs: Genus *Piper sp.* which is represented by 4 species, but just with *Piper nigrum* L. is known correctness of designation, remaining 3 not and should be confirm by authorized botanist. And same problem is with rest “not sure species”. See them in Table 7.

Table 7. Plants identified on genus level in the Tropical greenhouse. Plants identified on species level but untrustworthy in the Tropical greenhouse.

Plants untrustworthy identified on species level	<i>Alocasia macrorrhizos</i> (L.) G. Don <i>Piper auritum</i> Kunth <i>Piper sarmentosum</i> Roxb. <i>Piper longum</i> L. <i>Malpighia glabra</i> L. <i>Crinum asiaticum</i> L. <i>Hylocereus undatus</i> (Haw) Britt. & Rose
Plants identified on genus level	<i>Anthurium</i> Schott <i>Hedera</i> L. <i>Adiantum</i> L. <i>Dracaena</i> Vand. ex L. <i>Guzmania</i> Ruiz & Pav. <i>Belamcanda</i> Adans. <i>Bombax</i> L. <i>Gossypium</i> L. <i>Aglaia</i> Lour. <i>Cattleya</i> Lindl. <i>Phalaenopsis</i> Blume <i>Epidendrum</i> L. <i>Vanda</i> Jones ex R. Br. <i>Phyllostachys</i> Siebold & Zucc. <i>Pilea</i> Lindl. <i>Aglaonema</i> Schott <i>Syngonium</i> Schott <i>Phyllocactus</i> Link <i>Atheranthera</i> Mast. <i>Ctenanthe</i> Eichl. <i>Maranta</i> L.

Table of credibility showed 9 plants which were written as Scientific name in previous list, but officially are synonyms. Four plants of genus *Eugenia* was change to genus *Syzygium*, because this is an accepted name: *Eugenia aquea* Burm.f. change to *Syzygium aqueum*

(Burm. f.) Alston, *Eugenia jambos* L. change to *Syzygium jambos* (L.) Alston, *Eugenia malaccensis* L. change to *Syzygium malaccense* (L.) Merr. & L.M. Perry, *Eugenia myrtifolia* Cambess. change to *Syzygium australe* (J.C. Wendl. ex Link) B. Hyland. Than *Boehmeria utilis* Gaudich var. 'Nivea' was changed to *Boehmeria nivea* (L.) Gaudich., because species wasn't correct and cultivar was removed. *Manilkara zapota* (L.) P.Royen was before mentioned as *Lucuma mammosa* C.F.Gaertn. and as *Achras sapota* L., but they are just a synonyms of *M. zapota*. Same problem was with *Manihot esculenta* Crantz previous designation was *Manihot utilissima* Pohl. and that is a synonym. Previously *Citrus grandis* (L.) Osbeck was enrolled in column Scientific name but *Citrus maxima* (Burm.) Merr. is stated as accepted name throughout all databases and *C. grandis* is a synonym. *Parmentiera edulis* DC. was mentioned before as accepted name but it is synonym of *Parmentiera aculeata* (Kunth) Seem.

With 13 items from collection of TG was determined small ambiguity. Belong to them are: *Strophanthus amboensis* (**Schinz**) Engl. & Pax, *Garcinia xanthochymus* Hook.f. **ex T.Anderson**, *Ipomoea batatas* (L.) Lam./ (**L.**) **Poir.**, these plants have unclarity with name of authors in the databases (highlighted names). Problem with names is also with *Strelitzia reginae*: inTropicos and PROT4U is shown *Strelitzia reginae* Aiton, in The Plant list is *Strelitzia reginae* Banks ex Aiton and IPNI come up with *Strelitzia reginae* Banks. *Musa × paradisiaca* L. where was missing symbol of hybrid (X) in previous list, because *Musa x paradisiaca* is hybrid between *M. acuminata* × *M. Balbisiana*. *Codiaeum variegatum* (L.) Rumph. ex A.Juss. was before *Croton variegatus* L. Here are a few plants, where author's name was incorrectly written in previous list: Change from *Paullinia cupana* **H.B. & K.** to *Paullinia cupana* **Kunth**. Change from *Flacourtia indica* Merr. to *Flacourtia indica* (**Burm. f.**) Merr. Change from *Citrus aurantium* **L.** to *Citrus aurantiifolia* (**Christm.**) **Swingle**. *Ophiopogon jaburan* Lodd. was changed to *Ophiopogon jaburan* (**Siebold**) Lodd. *Cola nitida* Schott & Endl was changed to *Cola nitida* (**Vent.**) Schott & Endl. *Antidesma buniis* Spreng. was changed to *Antidesma buniis* (**L.**) Spreng.

Here is just 1 plant where data differ and is not sure correct name: *Seemannia sylvatica* (Kunth) Hanst. Tropicos says that is possible use also *Gloxinia sylvatica* (Kunth) Wiehler as acceptance name. On The Plant list is *G. sylvatica* unresolved name, and for GRIN Taxonomy is *G. sylvatica* synonym of *Seemannia sylvatica*. Other databases doesn't contain these names at all.

5.3. Table greenhouse

Table greenhouse has largest content of plants. Total number is 223. Main purpose of this greenhouse is storage of plants which doesn't have fix position in the Subtropical or Tropical GH or which are used for research. Family *Arecaceae* has the highest number of species: 28, second position of the abundance of species takes family *Fabaceae* with 18 species and third position has *Myrtaceae* with 15 species. Family *Rubiaceae*, *Araceae*, *Zingiberaceae*, *Poaceae*, *Euphorbiaceae*, *Passifloraceae*, and *Lamiaceae* have from 5 to 7 plants. Rest 76 families have 1-4 plants. To the collection of Table GH were added 87 plants and removed 141 plants based on inventorization. Table GH is very dynamic, and plants are changing most often from all greenhouses. **The table of revised plants and the table of recommended changes for Table greenhouse is recorded on attached CD.**

8 plants were assigned to not actual family and were revised to valid families at present. Control was made by APG classification.

Table 8. Families which have been changes based on APG in Table greenhouse.

Plant name	Previous family	Revised family
<i>Asparagus falcatus</i> L.	<i>Liliaceae</i>	<i>Asparagaceae</i>
<i>Spathodea</i> P.Beauv.	<i>Bixaceae</i>	<i>Bignoniaceae</i>
<i>Ceiba pentandra</i> (L.) Gaertn.	<i>Bombacaceae</i>	<i>Malvaceae</i>
<i>Cola nitida</i> (Vent.) Schott & Endl	<i>Sterculiaceae</i>	<i>Malvaceae</i>
<i>Flacourtia indica</i> (Burm. f.) Merr.	<i>Flacourtiaceae</i>	<i>Salicaceae</i>
<i>Russelia equisetiformis</i> Schltdl. & Cham.	<i>Scrophulariaceae</i>	<i>Plantaginaceae</i>
<i>Podocarpus macrophyllus</i> (Thunb.) Sweet	<i>Verbenaceae</i>	<i>Podocarpaceae</i>
<i>Parmentiera aculeata</i> (Kunth) Seem.	<i>Solanaceae</i>	<i>Bignoniaceae</i>

154 plants was assigned number 1 from table of credibility which means that were verified and confirmed family, genus, species in the databases.

Identified plants on genus level are 25 in Table GH. With two plants *Sabal japa* C. Wright ex Becc. and *Callistemon viridiflorus* (Sims) Sweet have identified species but untrustworthy. Databases shown, that *S. japa* is invalid name in databases. *C. viridiflorus* is labeled in greenhouse *C. viridiform* but it doesn't exist and correct should be *C. viridiflorus* or another species.

Table 9. Plants identified only on genus level in the Table greenhouse.

Plants identified on genus level	
	<i>Dracontium</i> L.
	<i>Trachycarpus</i> H. Wendl.
	<i>Livistona</i> R. Br.
	<i>Dictyosperma</i> H. Wendl. & Drude
	<i>Areca</i> L.
	<i>Ruscus</i> L.
	<i>Begonia</i> L.
	<i>Tabebuia</i> Gomes ex DC.
	<i>Spathodea</i> P.Beauv.
	<i>Guzmania</i> Ruiz & Pav.
	<i>Calophyllum</i> L.
	<i>Terminalia</i> L.
	<i>Jatropha</i> L.
	<i>Mucuna</i> Adans.
	<i>Quercus</i> L.
	<i>Clerodendrum</i> L.
	<i>Bombax</i> L.
	<i>Adansonia</i> L.
	<i>Ctenanthe</i> Eichler
	<i>Artocarpus</i> J.R. Forst. & G. Forst.
	<i>Eucalyptus</i> L'Hér.
	<i>Pogonatherum</i> P. Beauv.
	<i>Bambusa</i> Schreb.
	<i>Muehlenbeckia</i> Meisn.
	<i>Murraya</i> J. Koenig ex L.

26 plants were assigned number 3 from Table of credibility. Firstly are presented plants which were in previous list mentioned as scientific name but databases shown them as synonyms. *Phyla dulcis* (Trevir.) Moldenke is accepted scientific name, but before was determined as accepted name *Lippia dulcis* Trevir., which is officially synonym of *Phyla dulcis*. *Sapindus saponaria* L. from family *Sapindaceae* is also accepted scientific name and previously was synonym *Sapindus mukorossi* Gaertn mention as official name. *Eucalyptus citriodora* Hook. is a synonym of *Corymbia citriodora* (Hook.) K.D.Hill & L.A.S.Johnson., but previously was *E. citriodora* written as accepted scientific name. And also *Belamcanda chinensis* (L.) DC. is a synonym of *Iris domestica* (L.) Goldblatt & Mabb., but previously was *B. chinensis* written as accepted scientific name.

Secondly are presented plants which databases differ in author's name. *Voacanga africana* is in the Plant List, IPNI: *Voacanga africana* Stapf ex S.Elliot. and in PROTA4U, Tropicos

Voacanga africana Stapf. With *Colophospermum mopane* GRIN, IPNI, Tropicos says *Colophospermum mopane* (J. Kirk ex Benth.) J. Léonard and The Plant list, PROTA4U *Colophospermum mopane* (Benth.) J.Léonard. In databases where is *Prunella grandiflora* mentioned, author's names differ. In Tropicos is *Prunella grandiflora* (L.) Jacq., in The Plant List is *Prunella grandiflora* (L.) Scholler, and in IPNI *Prunella grandiflora* Jacq. *Strelitzia reginae* has author's name in Tropicos, PROTA4U, GRIN *Strelitzia reginae* Aiton, in IPNI *Strelitzia reginae* Banks, and in The Plant List *Strelitzia reginae* Banks ex Aiton.

To following genera of plants were added species: *Treculia africana* Decne, *Philodendron elegans* K. Krause, *Cyperus alternifolius* L. At the last from category 3 of Table of credibility is provide table of plant, which had wrong designation of authors in previous list of plants from Table greenhouse.

Table 10. Plants from Table greenhouse which had wrong designation of authors in previous list of plants and adequate revision of authors' names is showing following table.

Previous name	Correct Scientific name
<i>Aegle marmelos</i> Corrêa	<i>Aegle marmelos</i> (L.) Corrêa
<i>Arrhenatherum elatius</i> P.Beauv.	<i>Arrhenatherum elatius</i> (L.) P. Beauv. ex J. Presl & C.Presl
<i>Berchemia discolor</i> (Klotzsch) Hemsl.	<i>Berchemia discolor</i> (Klotzsch) Hemsl.
<i>Butia eriospatha</i> Becc.	<i>Butia eriospatha</i> (Mart. ex Drude) Becc.
<i>Callistemon citrinus</i> Skeels	<i>Callistemon citrinus</i> (Curtis) Skeels
<i>Carissa macrocarpa</i> A.DC.	<i>Carissa macrocarpa</i> (Eckl.) A. DC.
<i>Cola nitida</i> A.Chev.	<i>Cola nitida</i> (Vent.) Schott & Endl
<i>Flacourtia indica</i> Merr.	<i>Flacourtia indica</i> (Burm. f.) Merr.
<i>Howea forsteriana</i> Becc.	<i>Howea forsteriana</i> (F. Muell. & H. Wendl.) Becc.
<i>Livistona chinensis</i> R.Br.	<i>Livistona chinensis</i> (Jacq.) R. Br. ex Mart.
<i>Mimosa pudica</i> Mill.	<i>Mimosa pudica</i> L.
<i>Parmentiera aculeata</i> Seem.	<i>Parmentiera aculeata</i> (Kunth) Seem.
<i>Polyscias fruticosa</i> Harms	<i>Polyscias fruticosa</i> (L.) Harms
<i>Ravenala madagascariensis</i> J.F.Gmel.	<i>Ravenala madagascariensis</i> Sonn.
<i>Roystonea regia</i> O.F. Cook	<i>Roystonea regia</i> (Kunth) O.F. Cook
<i>Synsepalum dulcificum</i> Baill.	<i>Synsepalum dulcificum</i> (Schumach. & Thonn.) Baill.
<i>Trachycarpus fortunei</i> H. Wendl.	<i>Trachycarpus fortunei</i> (Hook.) H. Wendl.
<i>Washingtonia filifera</i> (Linden ex André) H. Wendl.	<i>Washingtonia filifera</i> (Linden ex André) H. Wendl. ex de Bary
<i>Zanthoxylum piperitum</i> Benn.	<i>Zanthoxylum piperitum</i> (L.) DC.

***Rollinia mucosa* (Jacq.) Baill.:** Databases differ with accepted name of *Rollinia mucosa* (Jacq.) Baill. Tropicos, The Plant List and PROTA4U says that accepted name is *Rollinia mucosa* (Jacq.) Baill., but on GRIN database is accepted name *Annona mucosa* Jacq. and *R. mucosa* a synonym. ***Thevetia peruviana* Merr. :** Tropicos and Plant List state as scientific name *Cascabela thevetia* (L.) Lippold, but GRIN and PROTA4U *Thevetia peruviana* Merr. ***Sabal blackburniana* Glazebrook:** The Plant List present *Sabal blackburniana* Glazebrook as synonym of *Sabal palmetto* (Walter) Lodd. ex Schult. & Schult.f.; on Tropicos and GRIN is accepted name *Sabal blackburniana* Glazebrook. ***Sabal umbraculifera* Mart.:** Tropicos is expressed about *Sabal umbraculifera* Mart. as the accepted name. The Plant List says that *Sabal umbraculifera* Mart. is a synonym of *Sabal palmetto* (Walter) Lodd. ex Schult. & Schult.f. GRIN state *Sabal umbraculifera* Mart. as synonym of *Sabal blackburniana* Glazebrook. ***Diospyros nigra* (J.F.Gmel.) Perrier:** *Diospyros nigra* is accepted scientific name on Tropicos and The Plant List, however on PROTA4U and GRIN is *Diospyros digyna* Jacq. accepted name and *D. nigra* synonym. ***Cissus javana* DC.:** *Cissus javana* DC. is scientific name on Tropicos and The Plant List, on GRIN is *Cissus discolor* Blume accepted name and *C. javana* synonym.

5.4. Outdoor collection

Outdoor collection is represented mainly by herbs and ornamental plants. This collection includes 149 plants. The most plants is from family *Lamiaceae* (28 plants), *Asteraceae* (17 plants), *Plantaginaceae* (17 plants), *Ranunculaceae* (12 plants), *Scrophulariaceae* (7 plants). It wasn't possible to make inventorization because during processing of this thesis were unsuitable weather conditions for growing of plant. Revision was made on previous list without updating by inventory. **The table of revised plants and the table of recommended changes for Outdoor collection is recorded on attached CD.**

The families which have been changed in Outdoor collection are following: all plants genus *Veronica* spp. (6 plants) and *Digitalis* spp. (8 plants) were erroneously classified to family *Scrophulariaceae* and by revision were fixed to right family which is *Plantaginaceae*. Total were revised 23 families. Other changed families are showed in Table 11.

Table 11. Families which have been changes based on APG in Outdoor collection

Plant name	Previous family	Revised family
<i>Allium ledebourianum</i> Schult. & Schult. f.	<i>Alliaceae</i>	<i>Amaryllidaceae</i>
<i>Allium schoenoprasum</i> L.	<i>Alliaceae</i>	<i>Amaryllidaceae</i>
<i>Anemarrhena asphodeloides</i> Bunge	<i>Anthericaceae</i>	<i>Asparagaceae</i>
<i>Convallaria majalis</i> L.	<i>Convallariaceae</i>	<i>Asparagaceae</i>
<i>Valeriana officinalis</i> L.	<i>Valerianaceae</i>	<i>Caprifoliaceae</i>
<i>Hypericum hirsutum</i> L.	<i>Clusiaceae</i>	<i>Hypericaceae</i>
<i>Hypericum olympicum</i> L.	<i>Clusiaceae</i>	<i>Hypericaceae</i>
<i>Hypericum perforatum</i> L.	<i>Clusiaceae</i>	<i>Hypericaceae</i>
<i>Plantago afra</i> L.	<i>Scrophulariaceae</i>	<i>Plantaginaceae</i>

115 plants were detected no mistake in family, genus and species. Also weren't found any plants identified only on genus level or with untrustworthy determine species. 10 plants are presented in Botanical garden as accepted name, but revision revealed that these plants are synonyms and official accepted names were found and repaired in table of plants; table 12.

Table 12. Plant synonyms which been previously mentioned as accepted names in Outdoor collection

Previous name; plant synonym	Correct Scientific name
<i>Balsamita major</i> Desf.	<i>Tanacetum balsamita</i> L.
<i>Chrysanthemum parthenium</i> (L.) Pers.	<i>Tanacetum parthenium</i> (L.) Sch.Bip.
<i>Lonicera altaica</i> Pall.	<i>Lonicera caerulea</i> var. <i>altaica</i> Pall.
<i>Sedum kirilowii</i> Regel	<i>Rhodiola kirilowii</i> (Regel)
<i>Althaea rosea</i> (L.) Cav.	<i>Alcea rosea</i> L.
<i>Digitalis ambigua</i> Murr.	<i>Digitalis grandiflora</i> Mill.
<i>Plantago psyllium</i> DC.	<i>Plantago afra</i> L.
<i>Cimicifuga racemosa</i> (L.) Nutt.	<i>Actaea racemosa</i> L.
<i>Bergenia cordifolia</i> Sternb.	<i>Bergenia crassifolia</i> (L.) Fritsch
<i>Verbascum thapsiforme</i> Schrad.	<i>Verbascum densiflorum</i> Bertol.

Left column showing plants name how were previously mentioned in Outdoor collection, but revision showed that these plants are synonyms and correct scientific name is in right column.

With 20 plants were changed author's name, or before were designate wrongly taxa below the rank of species. Table 13 clearly showing changes.

Table 13. Small ambiguity with plant names were found by revision and corrected in Outdoor collection.

Previous name	Correct Scientific name
<i>Acanthus mollis</i> Riedl ex Nees	<i>Acanthus mollis</i> L.
<i>Allium rotundum</i> L. subsp. "jajlae"	<i>Allium rotundum</i> subsp. <i>jajlae</i> (Vved.) B. Mathew
<i>Eryngium planum</i> Lindl.	<i>Eryngium planum</i> L.
<i>Ferulla assa-foetida</i> Martyn	<i>Ferula assa-foetida</i> L.
<i>Anchusa officinalis</i> Thunb.	<i>Anchusa officinalis</i> L.
<i>Codonopsis pilosula</i> Nannf.	<i>Codonopsis pilosula</i> (Franch.) Nannf.
<i>Platycodon grandiflorum</i> A.DC.	<i>Platycodon grandiflorus</i> (Jacq.) A. DC.
<i>Iris sanguinea</i> Donn	<i>Iris sanguinea</i> Donn ex Hornem.
<i>Hyssopus officinalis</i> L. ssp. "aristatus"	<i>Hyssopus officinalis</i> subsp. <i>aristatus</i> (Godr.) Nyman
<i>Hyssopus officinalis</i> L. var. "alba"	<i>Hyssopus officinalis</i> fo. <i>albus</i> Alef.
<i>Leonurus cardiaca</i> L. ssp. "intermedium"	<i>Leonurus cardiaca</i> subsp. <i>intermedius</i> (Holub) Dostál
<i>Mentha piperita</i> L.	<i>Mentha</i> × <i>piperita</i> L.
<i>Origanum tyttanthum</i> Gontsch.	<i>Origanum vulgare</i> subsp. <i>gracile</i> (K.Koch) Ietsw.
<i>Origanum vulgare</i> L. ssp. "hirtum"	<i>Origanum vulgare</i> subsp. <i>hirtum</i> Ietsw.
<i>Pogostemon cablin</i> Benth.	<i>Pogostemon cablin</i> (Blanco) Benth.
<i>Salvia nemorosa</i> Baumq. ex Nyman	<i>Salvia nemorosa</i> L.
<i>Scutellaria altissima</i> A.Ham.	<i>Scutellaria altissima</i> L.
<i>Sideritis syriaca</i> Pall. Ex M.Bieb.	<i>Sideritis syriaca</i> L.
<i>Digitalis lutea</i> Sibth. & Sm.	<i>Digitalis lutea</i> L.
<i>Anemone rivularis</i> Wall.	<i>Anemone rivularis</i> Buch.-Ham. ex DC.

All species of genus *Leuzea* in Outdoor collection were checked in databases, but were found just on database The Plant List where were determine as synonym of genus *Rhaponticum*. This was a reason why 3 plants of genus *Leuzea/Rhaponticum* got symbol 4 from table of credibility: wasn't clear correctness. Another unclear plant is *Rhodiola arctica* Boriss; Tropicos come up with *Rhodiola arctica* Boriss as accepted scientific name but The Plant List says: *Rhodiola arctica* Boriss. is a synonym of *Sedum roseum* (L.) Scop. Also was assigned symbol 4 from table of credibility because of unclarity.

5.5. Lysimetric greenhouse

Objective of Lysimetric greenhouse is storage primarily of genus *Citrus* spp. Revision was done but it is too subjective and just small nomenclature changes are recommended for management of botanical garden. 32 plants from Lysimetric greenhouse belong to family *Rutaceae* and just one plant *Vitis vinifera* L. assigned to family *Vitaceae*.

All cultivars were determined incorrectly, shown on example: *Citrus sinensis* cv. 'Hamlin'; and based on the International Code of Nomenclature for Cultivated Plants (ICNCP)

(Brickell, 2009) is correct designation like this: *Citrus sinensis* 'Hamlin'. 23 cultivars in Lysimetric greenhouse were changed based on ICNCP. Other changes are not recommended by this thesis because databases did not show relevant evaluation.

Revision was done primarily on GRIN taxonomy and Mansfeld's database because these databases are specialised on agricultural crops and Lysimetric greenhouse is covered by agricultural crops: Citruses. Plants to which were assigned symbol 4 from Table of credibility are described in following text. *Citrus leiocarpa hort. ex Tanaka*, *Citrus pyriformis Hassk.*, were found and accepted by GRIN taxonomy and Tropicos. Another databases doesn't contain this species or showing these two species as synonyms.

Citrus limon var. Meyeri doesn't exist on any databases probably is this variety incorrectly designed in the Botanical garden. GRIN taxonomy comes up with *Citrus sunki (Hayata) hort. ex Tanaka*. Mansfeld's database says about *C. sunki* that is a synonym of *Citrus reticulata var. austera* Swingle. Name in the Lysimetric greenhouse was accepted based on GRIN taxonomy. *Fortunella × obovata hort. ex Tanaka* is on GRIN taxonomy. *Fortunella obovata* Tanaka is a synonym of *Citrus japonica* Thunb. on Tropicos and The Plant list. And Mansfeld's databases agree with GRIN but does not contain symbol of hybrid (X).

6. Discussion

In this thesis were total controlled 569 plant items and 111 families. Results showed significant changes in some plant names and families, but how much is taxonomical and nomenclatural revision reliable?

Control of families was made by APG, which is most recognized classification of the seed plants, focus on orders and families at present. Previous high use classification (as Cronquist, Thorne and Takhtajan classifications) doesn't reflected phylogenetic relationships of flowering plant as APG and older classification "...were based on selected similarities and differences in morphology rather than cladistic analysis of larger data sets involving DNA sequences or other forms of systematic data." (APG II, 2003) The close cooperation between chosen databases and APG is observed. Most of the databases ensue APG classification. The Plant List state that: "Genera and species of Angiosperms are presented in families following family circumscriptions in The Angiosperm Phylogeny Group, 2009" (The Plant List, 2010). Also Tropicos have in own references APG I, II, and III (Missouri Botanical Garden, 2013), and on official website of APG is possible to find link on Tropicos; from this we can deduce their cooperation. GRIN taxonomy is saying "The family to which each genus is assigned is provided, and any alternative family classifications in current use are indicated". It means that even not accepted family according to APG are mention on GRIN. Taxonomy on GRIN has been created with help over 200 taxonomic specialists and is continuously updated from current literature. (USDA, 2013). However concrete cooperation with APG was not found, nevertheless most of the family data on GRIN were match with Tropicos and The Plant List. PROTA4U doesn't contain so evident information about families and APG at first sight. Each plant has mentioned family and below is link "show more (x)" and after click show up links to other databases and their designation of families for stated plant. For example *Cola nitida* (Vent.) Schott & Endl. on PROTA4U belong to family *Sterculiaceae*, after click "show more (12)" appear among 12 links also: *Malvaceae* {RBG-KEW, APG Family}. (PROTA, 2000). Mansfeld Database is not relevant for revision of families, because data doesn't connected with APG. Even database are connected with each other. We can observe it on Tropicos which refer to 10 other databases for example to The Plant List, IPNI, JSTOR Plant Science, Australian Plant Name Index (APNI), etc. (Missouri Botanical Garden, 2013). GRIN taxonomy and Mansfeld's database also refer to other databases, which helping users to easily found information stated plant in other resources.

Databases used for purpose on this thesis are widely used online tools for researchers and students who take interest in botany. Data on Tropicos are mainly collected by large floristic projects as Flora of North America, Flora of China and Flora Mesoamericana, etc. and other floristic institutions. All the project and institutions involve many authors which collecting data. (Missouri Botanical Garden, 2013). The plant List says on own website about creating: “The Plant List has been developed as collaborative venture coordinated at the Royal Botanic Gardens, Kew and Missouri Botanical Garden and relying on the generosity of many collaborators who manage significant taxonomic data resources. The purpose was to merge into a single consistent database the best of the nomenclatural information available in these diverse data resources through a defined and automated process” (The Plant List, 2010). On these two examples we can observe, that databases are creating with the aid of many collaborators mainly under the auspices of big institutions as Missouri Botanical Garden, KEW, in case of GRIN taxonomy it is United States Department of Agriculture etc. From this we can conclude that used databases are objective and appropriate for purpose of this thesis.

The plants grown in the botanical gardens need to be correctly identified and documented. Record keeping of plant collection is one of the key activities which constitute the essence of a botanical garden. (Leadlay et al., 1998). At the present the best way to documented collection is recording information about plants to database software. However the Botanical garden of FTA does not use this method documentation yet. For example main Czech botanical gardens (as Prague Botanic Garden, Charles University Botanical Garden in Prague, Botanical Garden of Teplice, and 8 more gardens) are connected and all of them use program Florius which records plants in botanical gardens. (Florius, 2007).

The benefit of created tables of greenhouses is that contain column with synonyms of plants. That will make easier work with the plants in the collection. For example *Ananas comosus* (L.) Merr. is official accepted name, but in literature could appear also names *Bromelia comosus* L., *Bromelia ananas* L., *Ananas ananas* (L.) Voss. Table of revised plants from Tropical greenhouse contain these names of pineapple: accepted name and synonyms.

7. Conclusion

By this thesis was made complete nomenclatural and taxonomical revision of plant collection of Botanical garden of Tropical AgriSciences, CULS Prague. Each plant was subjected to revision through taxonomic databases Tropicos, The Plant List, GRIN Taxonomy for Plants, The Mansfeld's World Database of Agriculture and Horticultural Crops, International Plant Name Index (IPNI), PROTA4U. Control of families was done through APG classification. It were created complete updated tables of living plant collection of the Botanical garden which should be use for future handling with plant collection; by this is mainly mean recording all plants to database software.

For the management of botanical gardens were created Tables of recommended changes to each greenhouse. They suggest plants names and families names which should be changed because the current labelling is not appropriate.

Synonyms of plants were also added. It is due that some plants is possible find in literature under synonym and not under the accepted name. From that reason is list of synonym advantage for future work with plant collection.

References

- Angiosperm Phylogeny Group, APG.** 1998. An ordinal classification of the families of flowering plants. *Ann. Mo. Bot. Gard.* 85:531–553.
- Angiosperm Phylogeny Group, APG.** 2003. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG II. *Botanical Journal of the Linnean Society.* 141: 399–436
- Angiosperm Phylogeny Group, APG.** 2009. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG III. *Botanical Journal of the Linnean Society.* 161: 105–121
- BGCI, Botanic gardens Conservation International.** 2007 Resource centre [online]. Available at <http://www.bgci.org/resources/> (accessed on 30 January 2013).
- Brickell et al.** 2009. International code of nomenclature for cultivated plants (8th ed.). Belgium. ISHS.
- Duchoň L.** 2008. Cataloguing of living plant collection of ITS CULS Prague and databasing the collection data. CULS. Prague.
- Faltýnek M, et al.** 2005. Přehled světových druhů a odrůd rodu *Citrus*. Praha.
- Florius.** 2007. Program evidence rostlin v botanických zahradách [online]. Available at <http://www.florius.org/> (accessed on 25 April 2013).
- Chase M W, Reveal J L.** 2009. A phylogenetic classification of the land plants to accompany APG III. *Botanical Journal of the Linnean Society.* 161: 122–127.
- International Association for Plant Taxonomy (IAPT).** 2006. International Code of Botanical Nomenclature (VIENNA CODE) [online]. Available at <http://www.iapt-taxon.org/icbn/main.htm> (accessed on 30 January 2013).
- International Association for Plant Taxonomy (IAPT).** 2012. International Code of Nomenclature for algae, fungi, and plants (Melbourne Code) [online]. Available at <http://www.iapt-taxon.org/nomen/main.php> (accessed on 30 January 2013).

- IPK Gatersleben.** 1998. The Mansfeld's World Database of Agriculture and Horticultural Crops. Available at http://mansfeld.ipkgatersleben.de/pls/htmlldb_pgrc/f?p=185:3:661178674395201 (accessed on 05 April 2013).
- IPNI, The International Plant Names Index.** (2012). Published on the Internet. Available at <http://www.ipni.org> (accessed on 05 April 2013).
- Leadley E, Greene J.** 1998. The Darwin Technical Manual for Botanical Gardens. Botanical Gardens Conservation International (BGCI). London, UK. 136 pp.
- Mártonfi P.** 2006. Systematika Cievnatých Rastlín. Slovenia, Košice. Vydavateľstvo Univerzity P. J. Šafárika.
- Missouri Botanical Garden.** 2013. Tropicos [online]. Saint Louis, Missouri. Available at <http://www.tropicos.org> (accessed on 05 April 2013).
- Missouri Botanical Garden.** 2013. Tropicos.org. [online]. Saint Louis, Missouri. Available at <http://www.missouribotanicalgarden.org/media/fact-pages/tropicos.aspx> (accessed on 13 April 2013).
- Moore G A.** 2001. Oranges and lemons: clues to the taxonomy of *Citrus* from molecular markers. *Trends in Genetics*. 17(9). 536-540.
- Nyffeler R, Egli U.** 2010. An up-to-date familial and suprafamilial classification of succulent plants. *Bradleya*, 28: 125 – 144.
- Ornduff R.** 1969. The systematics of populations in plants. USA, Washington DC. The National Academies Press.
- PROTA, Plant Resources of Tropical Africa.** 2000. PROTA4U: Search Screen. Available at <http://www.prota4u.org/> (accessed on 05 April 2013).
- Royal Botanic Gardens, Kew.** 2013. International Plant Names Index (IPNI). [online]. Available at <http://www.kew.org/science-research-data/directory/projects/IPNI.htm> (accessed on 05 April 2013).
- Schuh, Randall T.** 2000. Biological systematics: principles and applications. USA, New York. Cornell University Press.

- Simpson M G.** 2006. Plant systematic. Canada. Elsevier Academic Press.
- Singh G.** 2004. Plant Systematics: An Integrated Approach. USA, New Hampshire. Science Publishers.
- Stevens P F.** 2001. Angiosperm Phylogeny Website: Version 12, July 2012. [online]. University of Missouri, St Louis. Available at <http://www.mobot.org/MOBOT/research/APweb/> (accessed on 05 April 2013).
- Stevens P F.** 1994. The Development of Biological Systematics: Antoine-Laurent de Jussieu, Nature, and the Natural System. USA, New York Chichester, West Sussex. Columbia University Press.
- Stuessy T F.** 2009. Classification, Taxonomy and Systematic. *Plant Taxonomy: The Systematic Evaluation of Comparative Data (2nd ed.)*. USA, New York Chichester, West Sussex. Columbia University Press. (pp. 5-9).
- Stuessy T F.** 2009. The Relevance of Systematic. *Plant Taxonomy: The Systematic Evaluation of Comparative Data (2nd ed.)*. USA, New York Chichester, West Sussex. Columbia University Press. (pp. 13-16).
- The Plant List.** 2010. Version 1. [online]. Published on the Internet. Available at <http://www.theplantlist.org/> (accessed on 05 April 2013).
- USDA, ARS, National Genetic Resources Program.** 2013. *Germplasm Resources Information Network - (GRIN)* [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. Available at http://www.ars-grin.gov/cgi-bin/npgs/html/tax_search.pl (accessed on 05 April 2013)
- USDA, Natural Resources Conservation Service.** 2013. Plant database: Classification. Available at <http://plants.usda.gov/java/ClassificationServlet?source=profile&symbol=MAIN3&display=31#> (accessed on 05 April 2013).
- Wilkins J S.** 2003. The origins of species concepts: History, characters, modes, and synapomorphies. Philosophy.
- Zelený V.** 1982. Botanika I.: 2. sv. Soustavná botanika. Praha. Vysoká škola zemědělská v Praze

Appendix

Appendix 1: Part from the table of Subtropical greenhouse which is shown as example.

Family	Scientific Name	Credibility	N	Synonyms
Actinidiaceae	<i>Actinidia chinensis</i> Planch.	1		
Anacardiaceae	<i>Pistacia vera</i> L.	1	N	
Annonaceae	<i>Annona cherimola</i> Mill.	1		<i>Annona pubescens</i> Salisb. <i>Annona tripetala</i> Aiton
Asparagaceae	<i>Yucca glauca</i> Nutt.	1		<i>Yucca angustifolia</i> Pursh <i>Yucca stricta</i> Sims
Asparagaceae	<i>Yucca</i> L.	2		
Capparaceae	<i>Capparis spinosa</i> L.	1		<i>Capparis murrayana</i> J. Graham
Caricaceae	<i>Carica</i> × <i>pentagona</i> Heilborn	3		<i>Vasconcellea</i> × <i>heilbornii</i> (V.M. Badillo) V.M. Badillo
Celastraceae	<i>Catha edulis</i> Forssk.	1		<i>Celastrus edulis</i> Vahl <i>Catha inermis</i> J.F.Gmel.
Cyperaceae	<i>Cyperus</i> L.	2	N	
Davalliaceae	<i>Nephrolepis exaltata</i> (L.) Schott	1	N	<i>Polypodium exaltatum</i> L. <i>Nephrodium exaltatum</i> (L.) R. Br.
Ebenaceae	<i>Diospyros kaki</i> Thunb.	1		
Lamiaceae	<i>Rosmarinus officinalis</i> L.	1		
Lauraceae	<i>Laurus nobilis</i> L.	1		
Lythraceae	<i>Punica granatum</i> L.	1		<i>Punica florida</i> Salisb. <i>Punica nana</i> L. <i>Punica spinosa</i> Lam.

Appendix 2: Table of Recommended changes for Subtropical greenhouse which is shown as example.

Table of recommended changes for Subtropical greenhouse			
Previous Family	Previous Scientific name	Revised Family	Revised Scientific name
Agavaceae	<i>Yucca glauca</i> Nutt.	Asparagaceae	<i>Yucca glauca</i> Nutt.
N	N	Asparagaceae	<i>Yucca</i> L.
Cappardiaceae	<i>Capparis spinosa</i> L.	Capparaceae	<i>Capparis spinosa</i> L.
Caricaceae	<i>Carica pentagona</i> Heliborn	Caricaceae	<i>Carica × pentagona</i> Heilborn
Myrtaceae	<i>Psidium cattleianum</i> Sab.	Myrtaceae	<i>Psidium cattleyanum</i> Sabine
Punicaceae	<i>Punica granatum</i> L. var. 'nana'	Lythraceae	<i>Punica granatum</i> L.
Rutaceae	<i>Citrus limonia</i> (L.) Osbeck	Rutaceae	<i>Citrus limonia</i>Osbeck
Rutaceae	<i>Citrus meyeri</i> Tan.	Rutaceae	<i>Citrus meyerii</i> Yu. Tanaka
Rutaceae	<i>Citrus deliciosa</i> Tan. <i>Citrus unshiu</i> Marc. <i>Citrus tangerina</i> Tan.	Rutaceae	<i>Citrus reticulata</i> Blanco.
Rutaceae	<i>Citrus sinensis</i> /L./ Osbeck. cv. 'Washington navel'	Rutaceae	<i>Citrus sinensis</i> 'Washington'
Rutaceae	<i>Citrus sinensis</i> /L./ Osbeck. cv. 'Hamlin'	Rutaceae	<i>Citrus sinensis</i> 'Hamlin'
Liliaceae	<i>Phormium tenax</i> Forst.	Xanthorrhoeaceae	<i>Phormium tenax</i> J.R. Forst. & G. Forst.
N	N	Xanthorrhoeaceae	<i>Phormium tenax</i> 'Purpureum'
N	N	Xanthorrhoeaceae	<i>Phormium tenax</i> 'Yellow wave'