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Ecological characteristics of natural and culturated species, their comparison in *Prunus* genus

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Summary: Plum species are found native throughout the nothern hemisphere, but mostly in the temperate zone. The earliest writings about plum date back some 2000 years (De Candolle, 1894; Cullinan, 1937) puts the age of plums at 2000-4000 years old (Bagenal, 1954). However, the stone core findings suggest a greater past. The question is difficult to conclude because the large number of species of the genus are taxonomically unclear and spread over a wide geographical area. The taxonomic position of stone fruit species and varieties can also be different, especially for *Prunus* species (Kárpáti, 1967; Terpó, 1974; Raming & Cociu, 1991; Faust & Surányi, 1997; Surányi, 2013). The study analyzes the average relative ecological value measurement numbers of 75 species, including 120 cultivars, in terms of diversity and similarity. It is novel that, based on the sources, the author used the Ellenberg-Borhid values for the European, Asian, North American and other species, expanding them with transitional subgenera (e.g. *Microcerasus*). It was also possible to pay attention to a North African, Central and South American *Prunus/Prunophora* species. Following the accounting of economic and fruiting values, the species, subspecies, and varieties of the European and Mediterranean regions are the finalists, but species hybrid plums, rootstocks, or *Prunus* species whose values have not yet been known can play a role. Although the kéköny is a known species, it can become a cultivated fruit species due to the high antioxidant content of the fruit (Hegedűs & Halász, 2019).

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Key words: *Prunus* genus, ecological characteristics, natural species, cultivated species

Introduction

Among the temperate fruit-bearing species, the plum offers an opportunity for a joint, comparative analysis of ecological and genetic diversity. Moreover, in terms of taxonomy and nutrition-physiology, there is already a difference in terms of the concept of plum fruit.

Examining the relative ecological indicator values of the parent species of the *Prunus domestica* and some related species (Surányi, 2006, 2014), we previously found it necessary to expand the Ellenberg-Borhidi model (Borhidi, 1995), thus increasing the informative role of the indicator numbers (Surányi, 2015, 2022).

However, in the current study, there are also evaluated a large number of non-6 cultivated wild species, possibly growing species used as subjects, as well as *Pruno*- and *Microcerasus* taxa. The relative biological value figures developed for cultivated plums, such as open pollination (OP), degree of frost resistance (FR), relative value of Sharka virus sensitivity (SS) and measuring of disease resistance (DR) data (Surányi, 2015) for non-cultivated plums they could not be available for plums (natural wild species).

Prunus sp. taxonomic investigation of species in the 17-18 up to the 20th century, many valuable results had already been achieved, but Kárpáti (1967) rightly claimed that the taxonomic problems of cultivated plum varieties cannot be closed - not even today. The present study is an attempt to determine whether the natural and cultivated forms of the plum can be examined together based on ecological relative values, namely in differentiation according to genetic (Hegedűs & Halász, 2019) and eco-geographical (Surányi, 2019) diversity.

Following studies of Duhamel Du Monceau (1768), Jahn et al. (1861), Oberdieck & Lucas (1875) limited themselves to the examination and systematization of European plums. Hegi (1906) also considered classic taxonomic aspects following Linné (1753), but Rehder (1940, 1954) and later Krüssmann (1978) evaluated the origin relationship of taxa more and more critically.

In Soó's (1965) well-known plant evolutionary history system, Bessey's (1915), Busch's (1944), and Hutchison's (1964) concept of tribal development also manifested itself. Rybin (1935, 1936), Crane & Lawrence (1952), Kovalev (1955), Endlich & Murawski (1962) the so-called clarified the origin of European plums, which was further clarified by Kárpáti (1967) with the help of morphological characters (petal, fruit and stone). This concept of Kárpáti (1967) was adopted by Kárpáti & Terpó (1968, 1971), Terpó (1974), as well as Terpó (1987) and Surányi (2013).

For the most part, pomology uses the tools and methods used for the sake of cultivars, therefore, floral biology (Dahl, 1935) or other vegetative and reproductive organ studies (Röder, 1940; Tóth, 1957; Surányi, 1991, 2019) are important additions. The economic advantages offered by the feverish variety production and variety exchanges pushed the ecological approach into the background, i.e. economic interests came to the fore. Fortunately, however, resistance issues became more prominent (Nicotra et al., 1983; Ramming & Cociu, 1991; Faust & Surányi, 1997; Surányi, 2019).

The role of diversity and its approach are not possible without ecological certification of old, actual and new varieties.

As we mentioned above, in the case of cultivated varieties, it became necessary to look for new indicators (cf. Surányi 2015, 2022). However, in order to be able to compare cultivated varieties and natural (wild) species, but now we could take them into account - due to the large number of wild species With all of this, the research result was to promote further breeding work by presenting the high species richness of the *Prunus* genus on the one hand, and using it on the other.

Materials and methods

More than 60 natural and cultivated species, as well as subspecies, types, and cultivars are included in large numbers in the study: 7 tables and an Appendix present the scope of the investigations. The investigated materials are there in the following.

Materials

A./ European plums and prunes

Prunus spinosa L.
- ssp. *fruticans*: Zagyva, Békési, Kőrösi, Jászapáti
- ssp *dasyphilla*: Lövőpetri 1-4

Prunus cerasifera Ehrh.
- ssp. *divaricata*: Dzsanka 1, Zsolta Afazka, Purpurovaja, Alutscha
- var. *cerasifera*: C. 1414, Myrobalan B, „Kutyaszilva", Vadszilva
- var. *myrobalana*: C. 162, C. 174, C. 359, C. 679

Prunus insititia Jusl.
- var. *Juliana*: St, Julien A, St. Julien B, St. Julien C, St. Julien D
- var. *alpina-orientalis*: Merryweather, Eiley, Scioty, Stoneless
- var. *leopoldiensis*: Damas C, Nemtudom szilva, Panyolai, Penyigei

Prunus domestica L.
- *P*. x *rybini*, *P*. x *media*, *Prunus domestica* var. *silvestris*, *Prunus domestica* var. *norica*,
- var. *silvestris*: Baki szilva, Berceli, Gönci szilva, Kecskeméti 101
- var. *hungarica*: Besztercei Bt. 2, Besztercei 150, Révfülöpi, Szarvasi
- Lombard cultivars: Belle, Field, Pond, Victoria
- German cultivars: Elena, Hanita, Hohenheim 4, Katinka

Prunus x *italica* (*P, domestica* x *P. insititia*) Borkh. em. Kárpáti
- convar. *pomariorum*: Cseresznyepiros, Katalán, Katalin, Piroska
- convar. *claudiana*: Bavay, Brahy, Oullins, Zöld ringló
- convar. *ovoidea*: Kék tojás, Piros tojás, Sárga tojás, Sötétkék tojás
- convar. *mamillaris*: Beregi datolya, Erdélyi nyakas, Gömöri nyakas, Orsó szilva

Prunus x *syriaca* (*P. cerasifera* x *P. domestica*) Borkh. em. Kárpáti
- convar. *prisca*, and more:
- convar. *cerea*: Bohn mirabella, Mirabellák királynője, Nancy, Sárga mirabella

B./ Other European species

Prunus pseudoarmeniaca Heldr. et Sart., *Prunus ramburii* Boiss.
Prunus cocomilia Ten.: Barackszilva, Pontbrianti, Royal kajsziszilva, Sermina

C./ Minor and Central Asian species and cvs

Prunus africana (Hook.fil.) Kalkman, *Prunus bochariensis* Schneid., *Prunus caspica* Kovalev et Ekinov, *Prunus curdica* Fenzl. et Fritsch., *Prunus darvasica* Temb., *Prunus iranica* N. N. Luneva et Erem., *Prunus monticola* K. Koch, *Prunus sogdiana* (Ledeb.) C.K. Schneid., *Prunus tadzhikistana* Erem. et Kozoc., *Prunus ursina* Kotschy, *Prunus* x *blireana* Adré, *Prunus* x *cistena* (N.E.Hansen) Koehne, *Prunus* x *gigantea* (Späth) Koehne, *Prunus* x *leiocarpa* (Boiss.) Fritsch. and more:
Prunus x *dasycarpa* Ehrh.: C. 154, C. 154/a, Erdélyi fekete, Fekete kajszi

D./ East Asian species and cvs.

Prunus consociiflora Schneid., *Prunus grandulosa* Thunb., *Prunus gymnodonta* Koehne, *Prunus rufa* Hook, *Prunus simonii* Carr., *Prunus sultana* Voss., *Prunus thibetica* Franch, and more:
Prunus salicina Lindl.: Black Amber, Black King, Elephant Heart, Giant Super
Prunus ussuriensis Kov. et Kost.: Dzhugaria, Karzianskaja, Sahalin, Ussurian

E./ Microcerasus species

Prunus besseyi Bailey, *Prunus pumila* L., *Prunus tienshanica* (Pojark.) S. Shi., *Prunus tomentosa* Thunb.

F./ Nord American species and cultivars

Prunus alabamensis C. Mohrh., *Prunus alleghaniensis* Porter, *Prunus brachypoda* Batarfin, *Prunus dumberi* Red., *Prunus geniculata* R. M. Harper, *Prunus gracilis* Engelm.et Gr., *Prunus gravisi* Small, *Prunus grayana* (Maxim.) C. K. Scheid., *Prunus harvadii* (W. Wight) S. C. Mason, *Prunus ilicifolia* (Nutt. ex Hook. et Am.) S. C. Mason, *Prunus lanata* (Sudw.) Mack. et Bush, *Prunus mexicana* S. Wats., *Prunus mitis* Beadle, *Prunus murrayana* Palmer, *Prunus othosepala* Koehne, *Prunus pensylvanica* L f., *Prunus prostrata* Labill., *Prunus reverchonii* Sarg., *Prunus rivularis* Scheele, *Prunus slavinii* E. J. Palm, *Prunus subcordata* Benth, *Prunus texana* D. Dietr., *Prunus venulosa* Sarg., *Prunus utahensis* Koehne, *Prunus virginiana* L.
and more:
Prunus americaca Marsh.: Cottrell, Ituska, Le Duc, Stoddard
Prunus angustifolia Marsh.: Chicasaw, Eagle, El Paso, Early Red
Prunus hortulana Bailey: Clark, Langsdon, Prairie Flower, Reed
Prunus maritima Marsh.: Autumn, Bassett, Hancock, Northneck
Prunus munsoniana Weight et Hedr.: Arkansas, Jewel, Munson hyb., Weigh 1
Prunus nigra Aiton: Aitkin, Canada, Cherry, Chinook
Prunus umbellata Elle: Black Sloe, Blue Sloe, Oldfield, Sloe

G./ Interspecific hybrid plums

Compass (*P. besseyi* x *hortulana*), Methley (*P. cerasifera* x *salicina*), Redcoat (*P. salicina* x *americana*), Sorriso di Primavera (*P. salicina* x *cerasifera*).

Methods

The expression of the ecological experiences in form of relative indicator values is not a new classification experiments to compare the ecological species. In this paper we consistently use Borhidi (1993, 1995) fundamental work of the ecological values of the indigenous flora of data it. At first, Iversen (1936) applied relative indicator values for characterizing salt-resistance of coastal plants, suggesting a three-grade scale. Ellenberg (1950, 1952) worked out the ecological indicator values of a larger number of meadow plants and different weeds for several ecological factors and the first experiment for applying these indicator values in typing plant communities. Ellenberg (1963) were applied 5-grade scales and the moisture scale amplified later to a 10-grade scale.

The development of the indicator values, an important contribution was made by Zólyomi's TWR system (1964) and that improved their staff (Zólyomi et al. 1967).

The TWR-system consisted of a 10-grade temperature scale (T), an 11-grade water content or soil moisture scale (W) and a 5-grade soil reaction scale (R), which was worked out to 1400 native species of the Hungarian flora and weeds (Kárpáti, 1978) and with some critical taxonomic groups (Borhidi, 1969 and others). The TWR formed an ecological reference system for plant communities and to place a multidimensional ecological space (cf. Précsényi, in Zólyomi 1964; Zólyomi & Précsényi, 1974; cit. Borhidi, 1993; Zólyomi, 1987).

Ellenberg (1974) elaborated an ecological behaviour indicator values with regard to the seven main environmental factors; three of them are climatic ones: temperature (T), light (L), and continentality (C), further three indicators related to soil factors, i.e. moisture or water supply (F), acidity or soil reaction (R) and nitrogen supply (N), the salinity has been recently actualized (Ellenberg et al. 1991). Although the indicator values of Ellenberg were not used in the Hungarian botanists, it had been included into the Synopsis of Soó (1964-1985): the TFRN-values of SOÓ can be obtained by dividing the Ellenberg's figures. Kovács (1979) elaborated the Ellenberg's indicator values of 1300 plant species of Romania and a register of other biological characteristics too. Borhidi (1993 and 1995) are found the ecological indicator values of the Hungarian flora in the following order, which we applied in recent study of pomological species. In the following, we take the figures as defined in Borhidi (1993 and 1995) study, as well as extend the cultivated fruit varieties in Hungarian cultural flora.

TB: The relative *temperature figures* reflecting the heat supply of the habitats where the species occur (mainly based on the distribution according to the latitudinal vegetation zones and altitudinal belts). The temperature figures of Ellenberg's 9-grade scale (T) applied by Borhidi (B) to the Hungarian flora. The relative figures indicate the following heat-climate belts or the corresponding microclimate conditions:

1. Subnival or supraboreal belt
2. Alpine, boreal or tundra belt
3. Subalpine or subboreal belt
4. Montane needle-leaved forest or taiga belt
5. Montane mesophilous broad-leaved forest belt
6. Submontane broad leaved forest belt
7. Thermophilous forest or woodland belt
8. Submediterranean woodland and grassland belt
9. Eumediterranean evergreen belt.

WB: The relative *moisture figures* (occurrence in relation to soil moisture or water table) according to the 12-grade F-scale of Ellenberg (1974). The scale is very similar to the W-scale of Zólyomi (1964), but the water plants have a more detailed categorization, as follows:

1. Plants of extremely dry habitats or bare rocks
2. Xero-indicators on habitats with long dry period
3. Xero-tolerants, but eventually occurring on fresh soils
4. Plants of semidry habitats
5. Plants of semihumid habitats, under intermediate conditions
6. Plants of fresh soils
7. Plants of moist soils not drying out and well aerated
8. Plants of moist soils tolerating short floods
9. Plants of wet, not well aerated soils
10. Plants of frequently flooded soils
11. Water plants with floating or partly emergent leaves
12. Water plants, most wholly submersed in water.

RB: *Reaction figures*, according to the nine-grade Ellenberg's scale, reflect to the occurrence of the plants in relation of the soil reaction of the habitats (Tüxen & Ellenberg, 1937). In the 5-grade Zólyomi's scale calciphilous and salt tolerant or even halophilous plants are equally treated as basiphilous plants. Here the two groups are differentiated by their positive or negative *salt figure* category. A comparison of the reaction value scales according to Ellenberg's versus Zólyomi's classification was carried out by Pichler & Karrer (1991, cit. Borhidi, 1995). The correspondent degrees are:

1. Plants of extremely acidic, explicitly calciumfree sites
2. Intermediate type between 1 and 3
3. Acidifrequent plants, mostly in acid soils
4. Plants of moderately acidic soils
5. Plants of slightly acid soils
6. Mostly on neutral soils but also in acid and basic ones, generally widely tolerant, more or less indifferent plants
7. Basifrequent plants, mostly on basic soils
8. Plants of basiphilous sites
9. Plants of explicitly calcareous sites and ultrabasic specialitsts
10. This scale slightly differs from the original Ellenberg's scale, due to the greater variety of the calci- and basiphilous habitats occurring in the warm-dry subcontinental and submediterranean climates. E.g. in the Ellenberg's scale 7 is the figure of the neutral habitats.

NB: *Nitrogen figures* according to Ellenberg's 9-grade scale, based on the occurrence in relation to the ammonia and nitrate supply of the habitats. Degrees:

1. Only in soils extremely poor in mineral nitrogen, e.g. peat bog plants
2. Plants of habitats very poor in nitrogen
3. Plants of moderately oligotrophic habitats
4. Plants of submesotrophic habitats
5. Plants of mesotrophic habitats
6. Plant of moderately nutrient rich habitats
7. Plants of soils rich in mineral nitrogen
8. N-indicator plants of fertilized soils
9. Plants only on hyperfertilized soil, extremely rich in mineral nitrogen (indicating pollution, manure deposition).

LB: *Light figures* according to Ellenberg's 9-grade scale, based on the occurrence of plants in relation to relative light intensity during summer time. Degrees:

1. Full shadow plants, often receiving less than 1%, rarely receiving more than 30% of the full day light
2. Very shadow-tolerant plants; photosynthetic minimum at 1 to 5% of full day light

3. Shadow plants; photosynthetic minimum under 5% relative light intensity, but survive more illuminated places
4. Shadow-half shadow plants; photosynthetic minimum between 5 and 10% relative light intensity
5. Half shadow plants receiving more than 10% but less than 100% relative light intensity
6. Half shadow-half light plants; photosynthetic minimum between 10 and 40% relative light intensity
7. Half light plants, mostly living in full light but also shadow tolerant
8. Light plants; photosynthetic minimum above 40% relative light intensity, less only in exceptional cases
9. Full light plants of open habitats not receiving less than 50% of relative light intensity.

KB: *Continentality values* according to Ellenberg's nine-grade scale based on the main distribution of plants according to degree of continentality of the general climate (see Meusel & Schubert, 1972) with emphasis on maximum and minimum temperature. Degrees:

1. Eu-oceanic species, reaching Central Europe only in the extreme West, not in Hungary
2. Oceanic species, mainly in West Europe and western Central Europe
3. Oceanic-suboceanic species are in whole Central Europe
4. Suboceanic species, mainly in Central Europe but reaching to East
5. Intermediate type with slight suboceanic-subcontinental character
6. Subcontinental, main area in eastern Central Europe
7. Continental-subcontinental species main area in East-Europe
8. Continental species reaching only eastern part of Central Europe
9. Eucontinental species, main area in Siberia and East Europe reaching scarcely the eastern part of Central Europe

SB: *Salt figures* for indicating plant occurrence in relation to the salt concentration of the soils in a 9-grade scale, according to Scherfose (1990).

1. Halophob species not occurring in salty or alkalic soils
2. Salt tolerant plants but living mainly on non-saline soils
3. Oligohaline plants living on soils of extremely few chloride content
4. Beta-mesohaline plants living on soils of few chloride content
5. Alfa/beta mesohaline plants living on soils of intermediate chloride content
6. Alfa-mesohaline plants living on soils of middle chloride content (0.7-0.9%)
7. Alfa-mesohaline to polyhaline plants living on soils of middle to high chloride content
8. Polyhaline plants on soils of high chloride content (1.2-1.6%)
9. Euhaline plants living on soils of very high chloride content
10. Euhaline to hypersaline plants living on soils of extremely high chloride content

The ecological conception by Borhidi diverts (1995) was same with the ecological figures of Ellenberg et al. (1991), although methodologically and in general concept follows it completely.

Results and discussion

The *Prunus* genus belongs to the *Rosaceae* family and includes a large number of species. They are partly of disputed taxonomic classification, mainly trees and shrubs, with very different ecological needs. Regarding the number of species, due to systematic differences, their number means at least 200-250 species (according to Plant List=PL or the Integrated Taxonomic Information System=ITIS). Terpó (1974) defined subgenera *(Padus*, *Cerasus*, *Microcerasus*, *Amygdalus*, *Prunus* - with several sectios), but Rehder (1954), Krüssman (1978), Ramming & Cociu (1991) followed a different classification - even within the genus *Prunus*. *Prunus* species are predominantly native to the northern hemisphere, in the temperate zone, and are mostly deciduous, but evergreens are also known. However, the area of some species is in Central America (*Prunus serotina* ssp. *capuli*) or the Andes (e.g. *Prunus amplifolia* Pilg.) (***Figure 1-15***).

The study could not undertake either a taxonomic or a wide-ranging (thus origin) comparative analysis, it only carried out an ecological assessment of the species that actually produce plum fruit and may provide them with rootstock. We drew attention to its importance in the recently published plum monograph. The taxonomic place and circle of kinship of domestic plum (Rehder, 1954; Ramming & Cociu, 1991; Faust & Surányi, 1997; Faust et al., 2011) and mostly the eco-geographical and morphological system of plum species and varieties (Surányi, 2019) formed the basis of this work.

Most authors consider the species *Prunus domestica* to be a spontaneous crossing of *P. spinosa* and *P. cerasifera*, which was also confirmed by recipt crossings (Rybin 1935, 1936; Kovalev, 1955; Kápáti, 1967; Ramming & Cociu, 1991). However, the parent species differ in size, lifestyle and fertility, as well as in relative temperature (TB) and light requirement (LB), as well as classification according to continentality (KB) (***Table 1***). The relative ecological values of the true European plum species showed significant differences only in a few cases; partly *P*. x *italica* and partly *P*. x *syriaca* differed from the other taxa (***Table 2***).

The number of species from Asia Minor and Central Asia is - true - high, but among them, the different scientific names given after the authors' definition are only synonyms. However, since we had no way to make a morphogenetic comparison and the relative ecological values were not sufficient to decide this, we included all of them as small species in ***Table 3***. In essence, this explains the low level of diversity; these are mainly montane species, they have high light requirements and high salt tolerance. This can be attributed to the fact that in Iran and Central Asia, more of the endogenous wild plums are being cultivated (own observations in 2002).

The similarity in ecological value is largely explained by the properties of *P. salicina* and the successful cross-breeding with other species over several centuries. And the plums from the Ussuri River region are somewhat different from the others because the ecological factors in Manchuria are also different from those in the interior regions of China, which shaped them over centuries (***Table 4***).

Table 1. *Relative ecological indicator values of different parents.*

PARENT SPECIES and OTHER TAXONS	**TB**	**WB**	**RB**	**NB**	**LB**	**KB**	**SB**
Prunus spinosa							
ssp. **fruticans**	**5.3**	**4.2**	**5.7**	**4.4**	**6.8**	**5.2**	**0**
ssp. **dasyphilla**	**5.1**	**3.9**	**6.4**	**3.8**	**7.2**	**5.0**	**0.1**
Prunus cerasifera							
var. **cerasifera**	**6.5**	**4.5**	**5.6**	**5.2**	**6.3**	**6.7**	**0-1**
ssp. **divaricata**	**6.2**	**5.4**	**5.6**	**4.9**	**5.6**	**6.3**	**0**
var. **myrobalana**	**6.1**	**4.6**	**5.2**	**5.1**	**5.8**	**6.1**	**0-1**
Test crossing							
Prunus x media	5	5-6	5-6	5	5	5-6	0
Prunus x rybini	5-6	6	5-6	5	5	5-6	0

Note: Taxon names in bold indicate the average of four cultivars, all other data are estimates.

Table 2. Main plum taxons and estimated types.

MAIN PLUM TAXONS	**TB**	**WB**	**RB**	**NB**	**LB**	**KB**	**SB**
Prunus insititia							
var. **Juliana**	**5.1**	**5.6**	**5.6**	**5.7**	**5.0**	**6.3**	**0**
var. **alpina-orientalis**	**5.2**	**5.4**	**5.7**	**5.5**	**5.2**	**5.9**	**0**
var. l**eopoldiensis**	**5.3**	**5.7**	**5.5**	**5.2**	**6.3**	**6.6**	**0**
Prunus domestica							
var. **silvestris**	**5.3**	**5.8**	**6.4**	**4.8**	**5.0**	**5.7**	**0**
var. norica	5	5	5-6	4-5	4-5	5	0
f. **hungarica**	**5.8**	**5.3**	**5.6**	**4.6**	**5.3**	**6.2**	**0**
Lombardian cvs.	**6.2**	**5.9**	**5.8**	**5.4**	**5.8**	**5.9**	**0**
German cvs	**5.8**	**6.0**	**5.8**	**5.4**	**5.7**	**5.8**	**0**
Prunus x italica							
convar. **pomariorum**	**5.5**	**5.6**	**5.4**	**5.6**	**5.2**	**5.4**	**0**
convar. **claudiana**	**5.9**	**6.1**	**5.8**	**5.7**	**6.4**	**6.0**	**0**
convar. **ovoidea**	**6.1**	**5.8**	**5.7**	**6.0**	**6.1**	**6.5**	**0**
convar. **mamillaris**	**6.4**	**5.9**	**6.1**	**5.3**	**6.4**	**5.7**	**0.1**
Prunus x syriaca							
convar. prisca	6	4-5	5-6	4-5	6	5-6	0-1
convar. **cerea**	**5.4**	**4.6**	**5.3**	**4.7**	**5.2**	**6.4**	**0**
FURTHER SPECIES and CULTIVARS							
Prunus cocomilia	**6.2**	**3.9**	**6.3**	**3.3**	**6.8**	**5.9**	**0**
Prunus pseudoarmaniaca	**6.4**	**3.8**	**6.1**	**3.4**	**7.2**	**5.6**	**0**
Prunus ramburii	7	3	6	3	6-7	6	0

Note: Taxon names in bold indicate the average of four cultivars, all other data are estimates.

Table 3. Estimated ecological values of wild and cultivated types for Minor and Central Asian plums.

SPECIES	**TB**	**WB**	**RB**	**NB**	**LB**	**KB**	**SB**
Prunus africana	7	3	6-7	3-4	7	6	0-1
Prunus bochariensis	6-7	3	6	2-3	7	5-6	0
Prunus caspica	5	3-4	6-7	3	6-7	5	0-1
Prunus curdica	5-6	4	6-7	3-4	7	5-6	0-1
Prunus darvasica	6-7	4	5-6	3-4	6-7	5-6	0-1
Prunus iranica	6-7	3-4	5	3-4	7	5-6	0-1
Prunus monticola	5	4	6	3	6.6	5.8	0
Prunus sogdiana	6-7	3	5-6	3-4	7	5-6	0
Prunus tadzhikistana	6-7	3-4	5	4	6-7	6	0-1
Prnus ursina	5-6	3-4	6	3	6-7	5	0
Prunus x blireana	5-6	4-5	5-6	3-4	6-7	5	0
Prunus x cistena	6	3-4	5	3	6	5	0
Prunus x dasycarpa*	**5.4**	**4.0**	**6.4**	**3.1**	**6.7**	**5.8**	**0**
Prunus x gigantea	6	4	6	3	6-7	5-6	0
Prunus x leiocarpa	5-6	4-5	5-6	3-4	6	5-6	0

Note: Taxon names in bold indicate the average of four cultivars, all other data are estimates.

Table 4. Ecological characterization of East Asian plums and cultivars.

SPECIES and CULTIVARS	TB	WB	RB	NB	LB	KB	SB
Prunus consociiflora	5-6	4-5	5-6	4-5	6	5	0
Prunus grandulosa	5	4-5	5-6	4	5	5-6	0-1
Prunus gymnodonta	5	4-5	5	4	6	5-6	0-1
Prunus rufa	5	5-6	5-6	5	6	6	0
Prunus salicina*	**6.2**	**4.9**	**5.8**	**4.9**	**6.7**	**5.6**	**0**
Prunus simonii	5-6	4-5	6	4-5	5-6	5-6	0
Prunus sultana	5	5	5	5	5-6	6	0
Prunus thibetica	5	5	5-6	4-5	5	5	0
Prunus ussuriensis*	**5.1**	**4.8**	**5.6**	**4.4**	**6.2**	**5.7**	**0-1**

Note: Taxon names in bold indicate the average of four cultivars, all other data are estimates.

Table 5. Microcerasus and North American plums and cultivars.

SPECIES and CULTIVARS	TB	WB	RB	NB	LB	KB	SB
MICROCERASUS SPECIES							
Prunus besseyi	4-5	4	5-6	4	6-7	5-6	0-1
Prunus pumila	5	4-5	5-6	4	7	5-6	0-1
Prunus tienshanica	5	4	5	3-4	6-7	6	0
Prunus tomentosa	4-5	4-5	6	4-5	7	6	0-1
NORTH AMERICAN PLUMS							
Prunus alabamensis	6	4-5	5	4-5	6-7	6	0
Prunus alleghaniensis	5-6	5	5	4	6-7	6	0
Prunus americana*	**5.0**	**4.5**	**5.6**	**4.5**	**6.1**	**5.7**	**0-1**
Prunus angustifolia*	**6.8**	**5.3**	**5.7**	**4.8**	**6.7**	**5.8**	**0**
Prunus brachypoda	5	4	5	3-4	6	6	0-1
Prunus dundari	5	5	5	4-5	6	6	0
Prunus geniculata	6-7	5	4-5	4-5	7	6	0-1
Prunus gracilis	5	4-5	5	4-5	6	5-6	0
Prunus gravisii	6	4-5	5	5	6-7	5-6	0
Prunus grayana	7	5	5	4-5	6	6	0
Prunus harvardii	5-6	4-5	4-5	5	6-7	6	0
Prunus hortulana*	**6.2**	**4.5**	**5.2**	**5.4**	**6.1**	**5.8**	**0**
Prunus ilicifolia	7	4	5-6	5	7	5-6	0-1
Prunus lanata	4-5	5	5	4-5	5-6	5-6	0-1
Prunus maritima*	**6.4**	**4.6**	**6.1**	**5.1**	**6.7**	**6.2**	**0**
Pprunus mexicana	7	4-5	5	4-5	7	5	0
Prunus mitis	6	4	5-6	5	5-6	5-6	0
Prunus munsoniana*	**5.7**	**4.5**	**5.7**	**4.6**	**6.1**	**6**	**0-1**
Prunus murrayana	6-7	5	5	4-5	6-7	6	0-1
Prunus nigra*	**5.6**	**4.7**	**5.2**	**5.1**	**6.2**	**5.3**	**0**
Prunus orthosepala	5-6	4	5	5	5-6	5	0
Prunus pensylvanica	5	5	5-6	4-5	6	5-6	0
Prunus prostrata	5	4	5	5	5-6	5	0-1
Prunus reverchonii	5-6	4	5	4-5	7	4	0
Prunus rivularis	6-7	4-5	5	5	6	4-5	0
Prunus slavinii	5-6	5	5-6	4	6-7	6	0
Prunus subcordata	6	4-5	5-6	4-5	6	5	0
Prunus texana	6-7	4	6	5	7	4-5	0
Prunus umbellata*	**7.2**	**4.8**	**5.6**	**4.9**	**5.7**	**5.3**	**0-1**
Prunus venulosa	6	4	6	4-5	6	6	0
Prunus utahensis	5-6	4	5	4-5	6-7	6	0
Prunus virginiana	5-6	4	5	4-5	6	5	0
INTERSPECIFIC HYBRIDS							
Average of hybrid cultivars*	**6.9**	**5.4**	**5.5**	**5.0**	**6.4**	**6.3**	**0.1**

Note: Taxon names in bold indicate the average of four cultivars, all other data are estimates.

Table 6. Caracterization of North American plums on based of TB values.

TB VALUES (calculated and estimated)	**TB**	**WB**	**RB**	**NB**	**LB**	**KB**	**SB**
4-5 n=1	4.50	5.00	5.00	4.50	5.50	5.50	0.50
5 n=6	5.00	4.50	5.18	4.50	5.92	5.62	0.05
5-6 n=9	5.53	4.41	5.08	4.58	6.31	5.48	0.01
6 n=7	6.08	4.37	5.47	4.86	6.18	5.71	0.00
6-7 n=5	6.56	4.86	5.24	4.76	6.64	5.34	0.04
7 n=4	7.05	4.57	5.25	4.72	6.42	5.45	0.04

Table 7. Description of geographical and genetic plum groups.

CHARACTERIZATED GROUPS	**TB**	**WB**	**RB**	**NB**	**LB**	**KB**	**SB**
Parent species and other taxons							
Prunus spinosa	5.20	4.05	6.05	4.10	7.00	5.10	0.05
Prunus cerasifera	6.27	4.83	5.47	5.06	5.90	6.37	0.07
Main plums and cultivars							
Prunus insititia	5.20	5.57	5.60	5.46	5.17	6.27	0.00
Prunus domestica	5.51	5.64	5.73	4.96	5.19	5.66	0.00
Prunus x italica	5.98	5.85	5.75	5.65	6.03	5.90	0.03
Prunus x syriaca	5.70	4.55	5.40	4.60	5.60	5.95	0.05
Further species and cultivars	6.53	3.57	6.13	3.23	6.83	5.83	0.00
Minor and Central Asian species and cultivars	5.86	3.43	5.79	3.27	6.61	5.16	0.04
East Asian plums and cultivars	5.26	4.80	5.49	4.53	5.77	5.53	0.03
Microcerasus species	4.75	4.25	5.50	4.00	6.75	5.75	0.08
North American plums	5.60	4.53	5.24	4.65	6.28	5.53	0.03
Interspecific hybrids	6.87	5.38	5.50	5.04	6.41	6.28	0.10

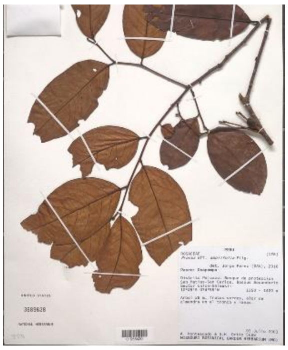

Figure 1. *Prunus amplifolia* (herbarium sheet, Smithonian Instituton)

Figure 2. *Prunus spinosa* (in natural flora)

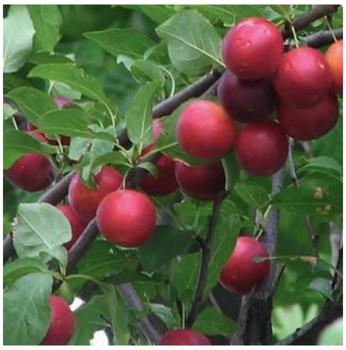

Figure 3. *Prunus cerasifera* (in gene bank)

Figure 4. *Prunus insititia* (cv. Penyigei, in orchard)

Figure 5. *Prunus hungarica* (Nm. 122, in orchard)

Figure 6. *P*. x *italica* (cv. Green gage, in orchard)

Figure 7. *P.* x *dasycarpa*
(Anatólia, in natural flora)

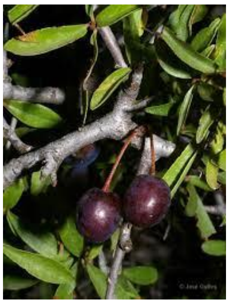

Figure 8. *Prunus ramburii*
(Andaluzia, in natural flora)

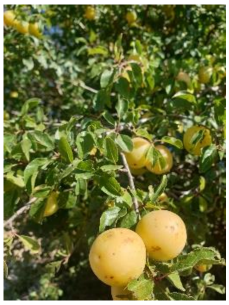

Figure 9. *Prunus cocomilia* (Peloponnészosz, in natural flora)

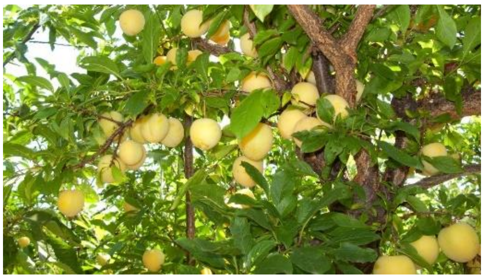

Figure 10. *Prunus salicina*
(cv. Shiro, in gene bank)

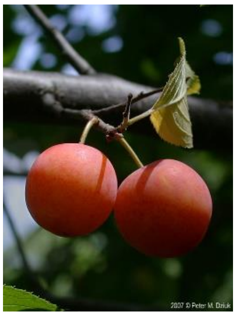

Figure 11. *Prunus nigra*
(in gene bank)

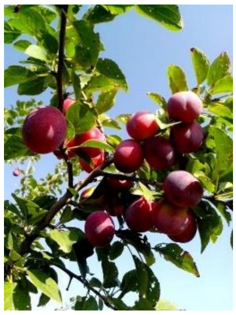

Figure 12. *Prunus munsoniana*
(in arboretum)

Figure 13. *Prunus geniculata*
(Atlas of Florida plums)

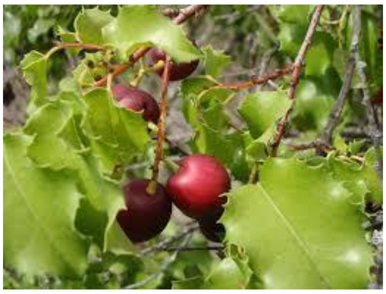

Figure 14. *Prunus ilicifolia*
(USA in natural flora)

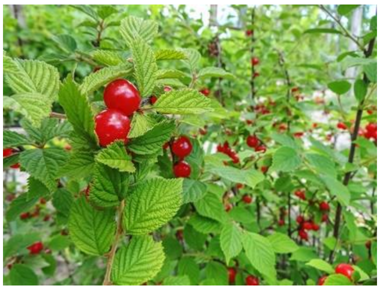

Figure 15. *Prunus tomentosa*
(in gene bank)

Hedrick et al. (1911), Rehder (1940), Nicotra et al. (1983), Ramming & Cociu (1991), Faust & Surányi (1997) and Surányi (2019) presented 32 plum species native to North America. Each of the 7 species that also plays a role in cultivation, as indicated by the note in ***Table 5***, is represented by the average of four varieties (species names in bold and asterisks). For the time being, New World species seem to have a more significant role in evolutionary biology, taxonomy and ecology. Because European and Japanese plums have a much greater nutritional weight worldwide, although in the Mediterranean region (California, Florida) *Prunus salicina* and its hybrid species dominate. In ***Table 5***, the species differed only slightly, based on the known descriptions. According to our assumptions, if a sufficient number of cultivated varieties of most species were available, ecological diversification would also be better appreciated.

Four *Microcerasus* species presented here separately, and it is not surprising that they are significantly different from the North American species. We know little about the *Prunus* species found in the Andes (only one herbarium sheet), just as little is known about the Central American subspecies of *P. serotina* there (*P. serotina* ssp. *capuli* /Cav./ Vaugh). According to the calculated and estimated TB data, the relative ecological values were found to be significant (***Table 6***). For the temperature values, a higher LB value could only be observed in the species group with TB 5-6 classification, otherwise the differences are within the margin of error.

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