

ARONIA MEDIK. IN THE NETHERLANDS I. DISTRIBUTION AND TAXONOMY

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SUMMARY

Since 1900 *Aronia* has spread vigorously in some nature reserves in The Netherlands. Almost all Dutch plants show characters intermediate between *A. melanocarpa* and *A. prunifolia*. From the fact that *Aronia* has been introduced into The Netherlands for horticultural purposes, and from the proved possibility of hybridization and back-crossing between *A. arbutifolia*, *A. melanocarpa*, and *A. prunifolia*, combined with the great variability of the Dutch populations, it is concluded that almost all *Aronia* plants in The Netherlands form part of a variable hybrid group that should be given the name *A. × prunifolia* (Marsh.) Rehd. Only at the site of its first introduction into The Netherlands (near Domburg, Zeeland) *A. arbutifolia* has been collected recently.

1. INTRODUCTION

The presence of *Aronia** (Rosaceae) in The Netherlands has been known since 1875. The shrubs were originally planted for ornamental purposes. Spreading to nature reserves probably took place in bird-droppings. In a number of reed marshes in the western part of the country where *Aronia* became established around 1920, it has become a nuisance, since its dense bushes impede normal mowing management. Under its rapidly spreading canopy nearly all other species become suppressed, and the characteristic reed marsh vegetation is in imminent danger of disappearing.

Problems in the management of nature reserves arising from this growth habit and difficulties in the determination of collected plants, led to an investigation of the history, the distribution, the ecology and the taxonomy of *Aronia* in The Netherlands. As *Aronia* also presents taxonomical problems in North America, where it is native, and several authors mention the existence of hybrids, extensive sampling was carried out in a number of Dutch populations in order to cover as much variability as possible.

2. MATERIALS AND METHODS

All sites in The Netherlands where *Aronia* had been gathered and from where it was mentioned in the literature, together with data obtained following an appeal by Dr. J. van Donselaar in 1974 (in *Gorteria* 7: 100), and newly discovered

*Nomenclature follows HEUKELS-VAN OOSTSTROOM (1977) unless otherwise stated.

Table 1. Origin and number of *Aronia* shoots analysed.

a. American herbarium specimens					
North Carolina	5	Alabama	1	Ohio	1
New York	3	Florida	1	Oregon	1
Maryland	2	Georgia	1	Rhode Island	1
Virginia	2	Massachusetts	1	Texas	1
		unknown	3		
b. Dutch herbarium specimens					
Domburg (Zeeland)	5	Ginneken (N-Brabant)	1		
Nieuwkoop (Z-Holland)	5	Hatert (Gelderland)	1		
Naardermeer (N-Holland)	3	Renswoude (Utrecht)	1		
Steenwijk (Overijssel)	2				
c. plants collected in 1978-1979					
Buitenliede (N-Holland)	43	Delft (Z-Holland)	8		
Binnenliede (N-Holland)	37	Ilperveld (N-Holland)	8		
Weerribben (Overijssel)	23	Nieuwkoop (Z-Holland)	6		
Oosteinderpoel (N-Holland)	15	Hoevelaken (Gelderland)	5		
Ginneken (N-Brabant)	14	Naardermeer (N-Holland)	5		
Oterleek (N-Holland)	11	Dalfsen (Overijssel)	2		
Amstelveen (N-Holland)	10	Wieden (Overijssel)	2		
Domburg (Zeeland)	10	Renswoude (Utrecht)	1		

sites during field trips were marked on ordnance maps (scale 1:25,000). Most sites were visited at least once in order to collect both flowering shoots and branches with ripe fruit. Herbarium material from the Rijksherbarium Leiden and the Rijksuniversiteit Utrecht comprising collections of both Dutch and American plants was also available for analysis.

Differences between the taxa described in floras are only given in relative terms (except the colour of the ripe fruit, which is according to HARDIN (1973) the only dependable character), such as the presence of few or many hairs or glands on different organs. The following characters were used to describe each of the collected shoots: the hairyness of the young shoots, of the buds, of the leaves, of the pedicels, and of the calyx lobes; the amount of glands on the calyx lobes; the colour, width, and persistency of the fruit. For each of these characters an arbitrary five-point scale was constructed. Each of the shoots available, in existing herbarium specimens as well as in my own Dutch collections, was described according to this method. Subsequently they were clustered into homogeneous groups. For each group bar charts were drawn of the evaluated characters. These bar charts were reconstructed to smooth curves and their vertical axes were transformed in order to obtain the same maximum height, so that the expression of a character and its frequency can be easily compared for each group.

As different floras show slight variations in their description of the characters used in this analysis, the same procedure was followed for the taxa found in 34 floras and descriptions of species. The frequency distributions obtained in this way were used as a standard to compare the groups of collected shoots and herbarium plants with. The origin and the numbers of shoots analysed are

given in *table 1*.

In reviewing the literature on the taxonomy of *Aronia* it became clear that different authors may hold quite different opinions on the taxonomic level on which the taxa are to be separated. As, moreover, both older (e.g. DIPPEL 1893) and recent (e.g. HARDIN 1973) literature refer to *A. prunifolia* as being the hybrid of *A. arbutifolia* and *A. melanocarpa* special attention was given to the treatment of this taxon by different authors.

3. SHORT SURVEY OF NOMENCLATURE IN ARONIA

From the history of the taxonomic status of the genus and its taxa it is clear that they still present taxonomical problems.

LINNAEUS (1753) described one species, using the name *Mespilus arbutifolia*. LAMARCK (1783) added a second species and used the names *Crataegus pirifolia* (= *Mespilus arbutifolia* L.) and *C. arbutifolia*. MARSHALL (1785), using the generic name *Mespilus*, described a third species, *M. prunifolia*. Since then the species have been treated under the genera *Hahnia* (MEDIKUS 1793), *Pyrus* (WILLDENOW 1799, following LINNÉ 1781), *Azarolus* (BORKHAUSEN 1803), *Aronia* (PERSON 1807), and *Sorbus* (HEYNHOLD 1840). Since 1950 both incorporation of the taxa into *Sorbus* (RADFORD et al. 1968) or *Pyrus* (SCOGGAN 1978), and distinction of a separate genus *Aronia* (e.g. GLEASON & CRONQUIST 1963) find support in the American floras. European floras commonly follow the opinion that *Aronia* is a separate genus.

Some authors describe the three taxa as varieties of one species (following WILLDENOW 1799). In later years WILLDENOW (1809) treated the taxa as separate species, however. The opinion that there are two species and that *A. prunifolia* is a variety of *A. arbutifolia* may also be found (following ROBINSON & FERNALD 1908). European floras commonly treat the taxa as separate species.

4. RESULTS

Aronia had already been brought to Europe from N-America before 1700. WEIN (1930) does not mention its introduction, but in the Banksian Herbarium of the British Museum (Natural History) reside plants of this genus that were collected in Great Britain in 1700. The eldest specimen collected in The Netherlands dates from 1875. From this first site ("Duinvliet" estate near Domburg, Zeeland) no new collections appeared since 1877, but in 1978 a healthy population was found on grounds formerly belonging to the "Duinvliet" estate. Before the end of the 19th century *Aronia* was collected in only one other place (near Steenwijk, Overijssel). Between 1900 and 1950 eight other sites became known. Since 1950 *Aronia* has been recorded from 34 hour-squares*. Most recordings could be localized to the nearest km². Counting of all records shows that *Aronia* has been

*An hour-square is a quadrat of 5 × 5 km. This grid system is used for the recording of floristic data. The Netherlands are divided in 1673 hour-squares.

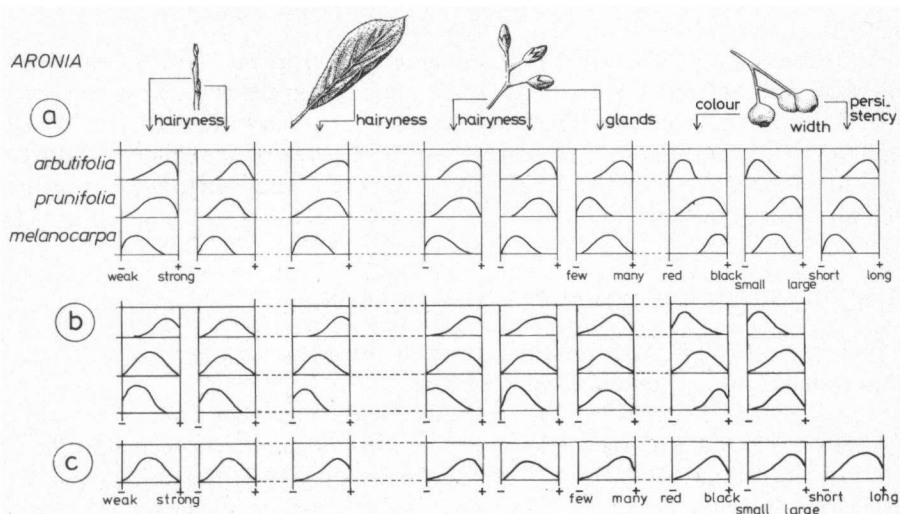


Fig. 1. Relative frequency and expression of some characters in *Aronia*.

a. as derived from the descriptions in a number of floras and species descriptions

b. following an analysis of American herbarium specimens

c. following an analysis of Dutch collections, except the plants from Domburg (see text for explanation)

found in at least 78 km-squares since 1950. In some cases a population comprised only a few individuals, in others 7–10 adjacent km-squares within a single hour-square are strewn with thousands of shrubs (Nieuwkoop, Z-Holland and Naardermeer, N-Holland). From the field observations it became clear that aggressive spreading in places where *Aronia* had run wild only occurred in reed marshes in the Dutch Haf District (BEENTJES 1979).

The evaluation of the characters of the taxa described in the literature surveyed was carried out as described above. The results are presented in *fig. 1a*. For most of the characters reviewed *A. prunifolia* holds an intermediate position. The same procedure applied to the American herbarium specimens available resulted in *fig. 1b*. The distribution and the relative frequency of the characters that were evaluated are in good accordance with *fig. 1a*. The analysis of both older Dutch herbarium specimens and recent collections revealed two clusters. One group comprised all the plants collected near Domburg, both the herbarium specimens from before 1900 and the recent collections. The plants come very well up to the description of *A. arbutifolia*. The other group showed mainly characters intermediate between *A. prunifolia* and *A. melanocarpa*. Even within one plant there could be much variation in the hairyiness of the inflorescences or the leaves. Variability in the colour of the fruit depended on their state of ripening. During the field work it had become clear that the fruit may retain a reddish colour until late August, changing to blackish in the course of September. Although most floras state that only the fruit of *A. arbutifolia* is long persistent, almost barren branches with small blackish fruit could be collected

as late as November. The distribution and the relative frequency of the characters of this group are given in *fig. 1c*. The great variation in the characters analysed in this group emerges from this figure. In some cases it is even wider than could be expected from the descriptions of *A. prunifolia*, the taxon with which the most resemblances exist. A single shoot from the Naardermeer (N-Holland) showed slightly more correspondence with *A. melanocarpa*, but all other collections from this area fell in the intermediate group.

The intermediate character of *A. prunifolia* led DIPPEL (1893), KOCH (1869), KOEHNE (1893), and SCHNEIDER (1906) already to the idea that this taxon could be the result of hybridization between *A. arbutifolia* and *A. melanocarpa*. The existence of such a hybrid has been mentioned by BRAUN (1969), FERNALD (1943, 1950), and REHDER (1927). This latter author states that this hybrid is indistinguishable from *A. prunifolia*. The possibility of hybridization between the different taxa of *Aronia* (and between *Aronia* and *Sorbus*) had also been indicated by SAX (1932, 1933) and SAX & SAX (1947). HARDIN (1973) did some crossing experiments and showed the possibility of hybridization between the three taxa. He states that *A. prunifolia* is a naturally occurring hybrid in the United States, that, as a result of back-crossing and subsequent introgression, has become a very variable hybrid group. From his experiments it also became clear that this hybrid is at least partly agamospermous. This character can be used to explain the small but persistent differences between populations. In the opinion of TEUSCHER (1933) this hybrid arose independently in Europe as a result of garden hybridization. The many varieties and forms described by DIPPEL (1893), KOCH (1869), KRÜSSMANN (1960), REHDER (1927, 1940), and SCHNEIDER (1906) might all be part of a widely variable hybridogeneous group, that has not been able to establish permanent characters in the continuing process of crossing and back-crossing.

5. CONCLUSIONS

Aronia has been imported to The Netherlands by commercial growers, but no evidence exists whether they imported "pure" species, or plants that had already undergone hybridization. Artificial hybridization has been carried out for the purpose of upgrading its horticultural properties, e.g. to combine the persistency of the fruit of *A. arbutifolia* with the red colouring of the leaves in autumn of *A. melanocarpa*. Most Dutch populations now show a combination of this red colouring and a more or less dense hairiness of the leaves and the inflorescences. The relatively isolated population near Domburg (Zeeland) is the only one that belongs to *A. arbutifolia*. All other populations show the intermediate and variable characters of *A. prunifolia*. Based on less extensive investigations their hybrid character has also been suggested by WIEGERS (1979).

Maintaining the generic name *Aronia*, and considering the taxa to be separated at the species level, the name of this hybrid complex should be *A. × prunifolia* (Marsh.) Rehd. This view is also adopted in the HEUKELS-VAN DER MEIJDEN flora (1983).

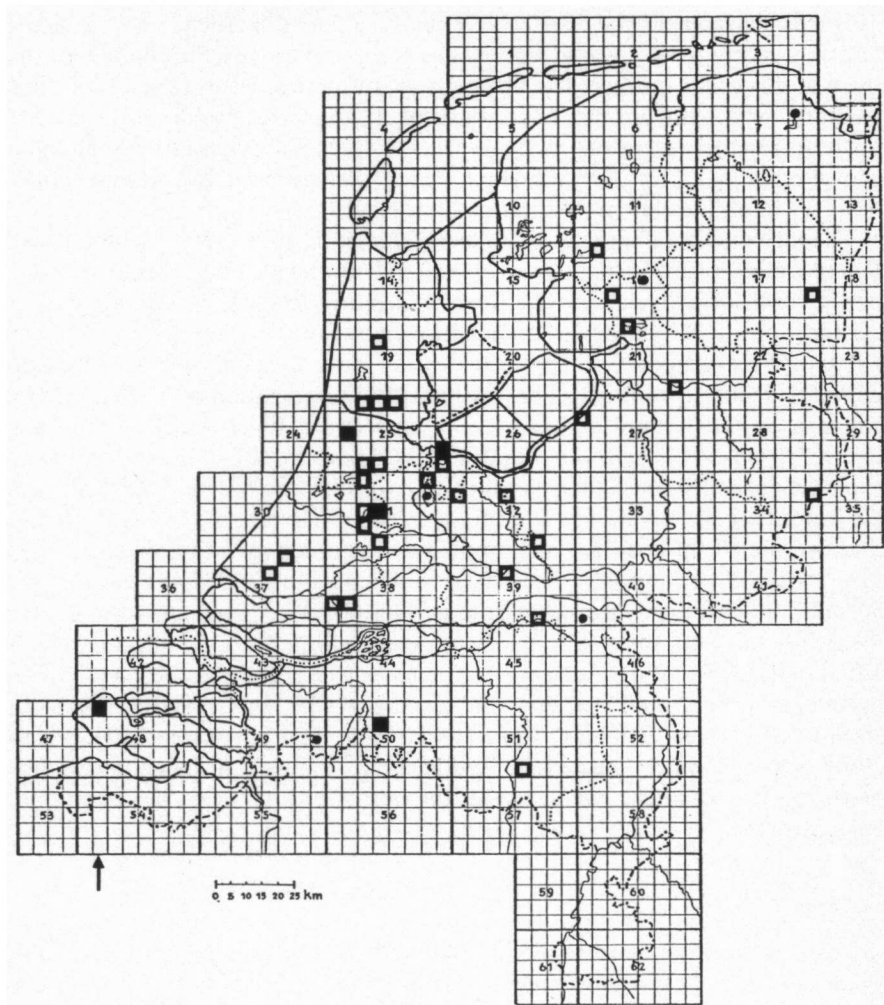


Fig. 2. The distribution of *Aronia* \times *prunifolia* (Marsh.) Rehd. in The Netherlands. The hour-square in which *A. arbutifolia* (L.) Pers. was collected is indicated with an arrow.

- distribution before 1950.
- distribution since 1950.
- records both before and since 1950.

The distribution map that can be drawn on the basis of these conclusions is presented in *fig. 2*. From the expansion of the hybrid since 1950 and the more detailed knowledge of its distribution before 1950, the frequency classes assigned to this taxon by ARNOLDS & VAN DER MEIJDEN (1976), following the system of VAN DER MAAREL (1971) need correction. For the period up to 1950 the frequency class is 2 and for the period 1950–1980 it is 4.

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REFERENCES

- ARNOLDS, E. J. M. & R. VAN DER MEIJDEN (1976): *Standaardlijst van de Nederlandse Flora*. Rijksherbarium, Leiden.
- BEENTJES, N. C. L. M. (1979): *Oecologie van de drie inheemse Aronia-soorten*. Int. Rapp. Hugo de Vries Laboratorium no. 74.
- BORKHAUSEN, M. B. (1803): *Theoretisches-Praktisches Handbuch der Forstbotanik und Forsttechnologie*. Heyer, Giessen und Darmstadt.
- BRAUN, E. L. (1969): *The woody Plants of Ohio*. Hafner, New York.
- DIPPEL, L. (1893): *Handbuch der Laubholzkunde III*. Parey, Berlin.
- FERNALD, M. L. (1943): Virginian botanizing under restrictions. *Rhodora* 45: 445–480.
- (1950): *Gray's Manual of Botany*. American Book Company, New York.
- GLEASON, H. A. (1952): *Illustrated Flora of the Northeastern United States and adjacent Canada*. Lancaster Press, Lancaster.
- & A. CRONQUIST (1963): *Manual of Vascular Plants*. Van Nostrand, New York.
- HARDIN, J. W. (1973): The enigmatic chokeberries (*Aronia*, Rosaceae). *Bull. Torrey Bot. Club* 100: 178–184.
- HEUKELS-VAN OOSTSTROOM (1977): *Flora van Nederland*. 19th ed. Wolters-Noordhoff, Groningen.
- HEUKELS-VAN DER MEIJDEN (1983): *Flora van Nederland*, 20th ed. Wolters-Noordhoff, Groningen.
- HEYNHOLD, G. (1840): *Nomenclator Botanicus Hortensis*. Arnold, Dresden und Leipzig.
- KOCH, K. (1869): *Dendrologie I*. Enke, Erlangen.
- KOEHN, E. (1893): *Deutsche Dendrologie*. Enke, Stuttgart.
- KRÜSMANN, G. (1960): *Handbuch der Laubgehölze I*. Parey, Berlin.
- LAMARCK, J. P. A. P. M. DE (1783): *Encyclopédie Méthodique*. Pancoucke, Paris.
- LINNAEUS, C. (1753): *Species Plantarum*. Salvii, Holmiae.
- LINNÉ, C. VON (1781): *Supplementum Plantarum*. Orphanotrophei, Brunsvigae.
- MAAREL, E. VAN DER (1971): Florastatistieken als bijdrage tot de evaluatie van natuurgebieden. *Gorteria* 5(7/10): 176–188.
- MARSHALL, H. (1785): *Arbustum Americanum*. Cruckshank, Philadelphia.
- MEDIKUS, F. K. (1793): *Geschichte der Botanik unserer Zeiten*. Schwan und Götz, Mannheim.
- PERSOON, C. H. (1807): *Synopsis Plantarum*. Cramer, Parisiis.
- RADFORD, A. E., H. E. AHLES & C. R. BELL (1968): *Manual of the Vascular Flora of the Carolinas*. University Press, Chapel Hill.
- REHDER, A. (1927): *Manual of Cultivated Trees and Shrubs*. Macmillan, New York.
- (1940): *Manual of Cultivated Trees and Shrubs*, 2nd ed. Macmillan, New York.
- ROBINSON, B. L. & M. L. FERNALD (1908): *Gray's Manual of Botany*. American Book Company, New York.
- SAX, H. J. & K. SAX (1947): The cytogenetics of generic hybrids of *Sorbus*. *Journ. Arnold Arb.* 28: 137–140.
- SAX, K. (1932): Chromosome relationships in the Pomoideae. *Journ. Arnold Arb.* 13: 363–367.
- (1933): The origin of the Pomoideae. *Proc. Amer. Soc. Hort. Sc.* 30: 147–150.
- SCHNEIDER, C. K. (1906): *Illustriertes Handbuch der Laubholzkunde I*. Fischer, Jena.
- SCOGGAN, H. J. (1978): *The Flora of Canada*. Nat. Mus. of Canada, Ottawa.
- TEUSCHER, H. (1933): Some suggestions of a horticulturist on the problem "What is a species?".

Torreya 33: 21–24.

WEIN, K. (1930): Die erste Einführung nordamerikanischer Gehölze in Europa. *Mitt. Deutsch. Dendr. Ges.* 42: 137–163.

WIEGERS, J. (1979): *Aronia* Medik. in The Netherlands: distribution and classification. *Acta Bot. Neerl.* 28(2/3): 239.

WILLDENOW, K. L. (1799): *Species Plantarum*. Nauk, Berolini.

— (1809): *Enumeratio Plantarum*. Hortus Berolinensis, Berolini.