

### Pre-Mendelian studies on the evolution of *Brassica* by Augustin Sageret over a century before Nagaharu U

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The Japanese Mendelian geneticist, Nagaharu U (1935), discovered the evolutionary scheme of three allopolyploid species of *Brassica* based on three diploid species of genome donors. U used both the chromosome numbers and synthetic hybrids to prove the model and showed that rutabaga could be synthesized by crossing turnip and cabbage.

While studying historical data on the origins of the allopolyploid species rutabaga, some ignored experiments by the French pre-Mendelian plant hybridizer Augustin Sageret described by de Candolle (1822, 1824) were noticed (Ahokas 2004). In the French original, de Candolle (1822) wrote "*Le colza, le chou-navet et le rutabaga paraissent tous, selon M. Sageret, des produits hybrides du chou et de la rave, mais pris dans divers degrés différens de culture et de domesticité. Aucune ne peut féconder le véritable chou, mais toutes sont fécondables par lui, toutes peuvent se féconder mutuellement et artificiellement et donner des produits féconds ... On pourrait croire que le colza pourrait provenir du croisement du chou et de la ravette, le chou à faucher par celui du chou avec la rave oblongue, le chou-navet par celui du chou avec la rabioule blanche, et le rutabaga par celui du chou avec la rabioule jaune*". In a German translation by C. F. W. Berg, the corresponding text reads "*Der Raps, die Kohlrübe und die Rutabaga, schienen alle, zu Folge Herrn Sageret, Bastarderzeugnisse des Kohls und der Rübe zu seyn, allain durch die Kultur verschiedentlich modificirt. Keine von ihnen vermag den wahren Kohl zu befruchten, alle dagegen sind der Befruchtung durch ihn fähig; auch vermögen sich alle wechselseitig zu befruchten, und dann wieder fruchtbare Erzeugnisse zu liefern ... Nicht unwahrscheinlich ist die Entstehung des Raps aus dem Kreuzen des Kohls und Rübens; des Schnittkohls aus dem des Kohls und der länglichen Rübe; der Kohlrübe aus dem des Kohls und der weißen abgeplatteten Rübe und der Rutabaga aus dem des Kohls und der gelben abgeplatteten Rübe*" (de Candolle 1824).

Thus, both oil seed and root crop rutabaga were shown to be of a hybrid origin from turnip and cabbage and diversified by selection in cultivation. Different types of the turnip species resulted in different types of the rutabaga species when hybridized with cabbage. Sageret (in de Candolle 1822, 1824) also noticed a strong interspecific incompatibility in cabbage as the seed parent and produced an intergeneric hybrid between cabbage and cultivated radish. Sageret himself probably did not write any article about his evolutionary studies on *Brassica*, but referred to these hybrids of *Brassic*as and that of *Brassica* and *Raphanus* in his later paper on hybrids of Cucurbitacees (Sageret 1826). In this paper Sageret also canonized the concept of dominance, the genetic term still in use.

The evolutionary history of rutabaga is described in detail in Ahokas (2004), from which the following summary is given here: Rutabaga is a cool season crop suffering from sterility of various kinds of gametic and embryo deformations when the temperature of the fecund stages exceeds 25 °C. Consequently the evolution of the species could have occurred only in a region with a relatively cool climate. Originally rutabaga was nowhere a wild species. It was described for the time in Finland in the 17<sup>th</sup> century. Another occurrence and a separate history of rutabaga is evident in Ingria (originally a Finnic territory later mostly known as St. Petersburg Government). Rutabaga was introduced to Central Scandinavia (in Sweden and Norway) by immigrating Finns around 1600. During his travels in North America in 1749, the Finnish explorer P. Kalm found that rutabaga was unknown there. Probably the earliest record of rutabaga in Germany (Erfurt area) as "*Kohlrabi unter der Erden*" appeared in 1748. Since then until the 20<sup>th</sup> century rutabaga was likewise recognised in several languages as the underground form of *Brassica olearacea* var. *gongyloides*. Rutabaga was introduced to England in 1767 from Sweden. It was introduced to France as *Chou de Lapponie* "some years" before the botanical encyclopaedia by Lamarck (1783) was written, possibly in connection with the return of Maupertuis' voyage to Finnish Lapland (1736–1737) described by Outhier (1746). Rutabaga was for

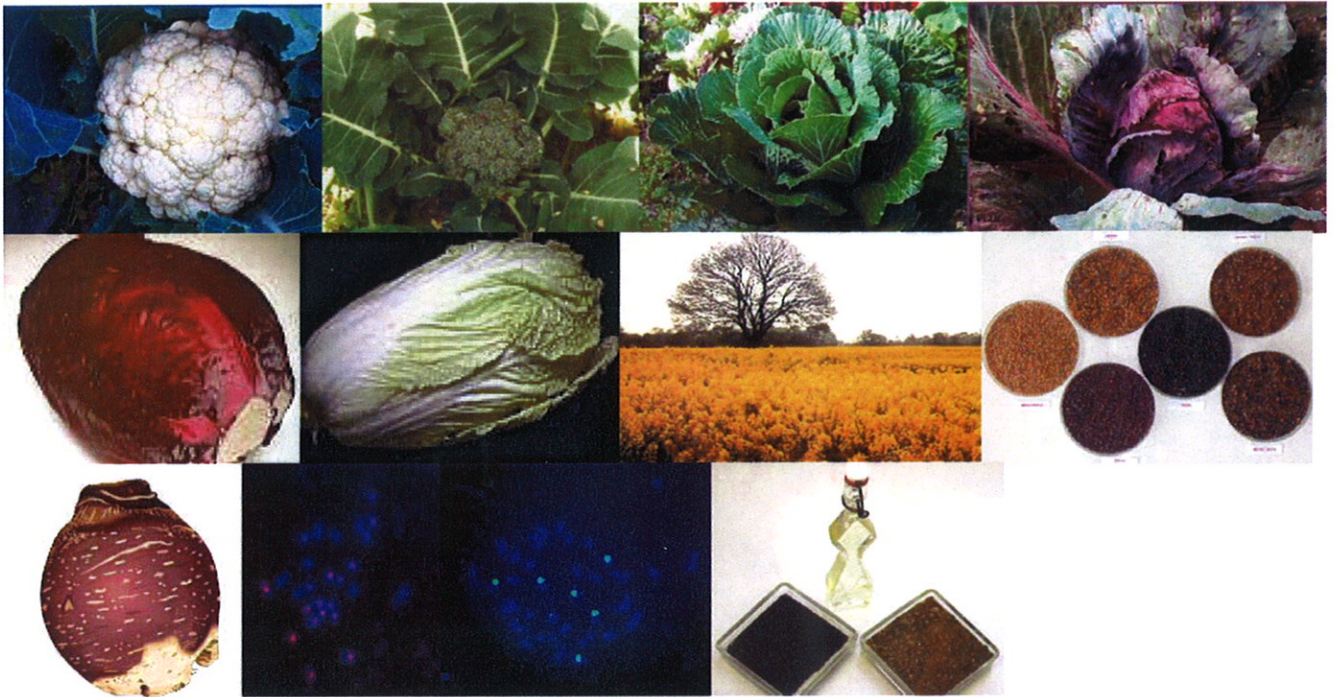
the second time introduced to France as *Navet de Suède*, *Chou-rutabaga* probably from England in ca. 1792 (Poiteau & Vilmorin 1843). Rutabaga diffused through Siberia, first with Ingrian refugees to Central Siberia from 1802 onwards distributing its Finnic names (e.g. *kaalikka* and *lanttu*), then reached North China in the 19<sup>th</sup> century, and was cultivated in Mongolia prior to 1923, when V. E. Pissarev and V. P. Kuzmin collected rutabaga of the Ingrian type there during the VIR collecting mission. The general Russian term for rutabaga, *bryúkva*, was introduced in the 19<sup>th</sup> century. In probably the first record of it, the Russian *bryúkva* was identified as rutabaga (Geitlin 1833), but may earlier have meant an elongated turnip. The word was loaned indirectly from the Latin *eruca*, probably via Italian *ruca*, German *wrucke*, *brucke* and similar, which did originally not denote rutabaga. An entry for rutabaga appeared in Chinese dictionaries towards the end of the 20<sup>th</sup> century.

Linnæus' *Napus* meant a turnip with an elongated root. Use of the name *napus* in the sense of rutabaga is erroneous. Identifications of the erroneous scientific name *Brassica napus*, originally as *Brassica Napus rapifera* Metzger (Metzger 1833) in the sense of rutabaga with ancient vernacular names for turnip, viz. *napu* (possibly an abbreviation of *sinapis*), *navet*, *navew*, *nave*, *nabo*, *nepo*, *næpo*, *napa*, etc. have resulted in an erroneous idea that rutabaga was an ancient species in Central and South Europe.

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