

GIDRE, 1989, Monografía del Trópico del Departamento de Cochabamba, Gidre, Cochabamba, Bolivia, 15-269

P.A.A.B., 1992, Qué camino debemos andar...- Elementos para una política ambiental boliviana, PL480-GTZ-Coop.Téc.Holandesa, Casilla 1508, La Paz, Bolivia, 1-24

Programa Agroquímico, 1990, Propuesta para la introducción y domesticación de especies medicinales y aromáticas, Programa Agroquímico, Universidad Mayor de San Simón, Casilla 992, Cochabamba, Bolivia

Programa Agroquímico, 1988, Proyecto de Aceites Esenciales Bolivia, Programa Agroquímico, Universidad Mayor de San Simón, Casilla 992, Cochabamba, Bolivia

Stolz, R., 1986, Posibilidades de Utilización de los recursos forestales tropicales del Norte y Este de Bolivia- Considerando aspectos Ecológicos. EGU-Kronberg Consulting+Engineering GMBH, 6240 Königstein, Sodener Strabe 6, Bonn, Alemania, 4-98

HISTORY AND BOTANY OF *CLAUSENA ANISUM-OLENS* (BLANCO) MERR.
CV. 'CLAUSANIS' (*RUTACEAE*), A PROMISING ESSENTIAL OIL CROP PLANT

J.-F. Molino
Laboratoire de Botanique
Institut de Botanique
163, rue Auguste Broussonet
34000 Montpellier
France

Fonds Documentaire IRD

Cote: B*24457 Ex: unique

Abstract

Studied in Indonesia around World War 2 under the name "*Clausena anisata* Hook.f.", this rutaceous tree whose leaves contain an essential oil consisting of almost pure anethole, is here identified as a cultivar of the Philippinan species *Clausena anisum-olens* (Blanco)Merr. The origin of this cv., still recently known only from a few cultivated trees in Bogor (Java), can be traced back to 1820, when the French botanist Perrottet collected living plants of *Clausena anisum-olens* near Manila and brought them back to Paris via La Réunion.

1. Introduction

On the occasion of a worldwide revision of the genus *Clausena* Burm.f., my attention was driven to a plant cultivated in the collections of the BALITTRO (Research Institute on Medicinal Plants and Spices) at Bogor (Java, Indonesia), whose origin and botanical identity appeared uncertain. After completion of the monograph of the genus; I propose here to classify this plant under the name:

Clausena anisum-olens (Blanco) Merrill cv. 'Clausanis'.

This entity is clearly defined by both botanical and chemical characteristics: the ovary is surmounted by a very short and dissymmetric style, an unusual feature in the genus *Clausena* but not important enough to make either specific or varietal difference with Philippinan *C. anisum-olens* var. *anisum-olens*. Moreover, recent experiments showed that, whatever the conditions of cultivation, the essential oil from leaves of cv. 'Clausanis' always contains about 98-99 % anethole and 0-1 % estragole (methyl chavicol), and that this character is also stable through sexual reproduction (Molino 1991).

A study on wild *C. anisum-olens* in the Philippines demonstrated the presence of at least three chemovariants for the composition of the essential oil from leaves, one of them bearing the same anethole content as cv. 'Clausanis', a second one in which estragole (methyl chavicol) replaces anethole, and a third one with a mixed composition. This phenotypic variance, stable within time and ecological conditions, proved to be of genetic origin (Molino 1991).

The total strength of the cultivar was limited, in 1986, to the small collection (two dozens) of individuals of the BALITTRO, and to a

Fonds Documentaire IRD



010024457

single tree cultivated in the Kebun Raya, the Royal Botanic Gardens at Bogor.

Incidentally, these plants have until now been known by the name of no botanical standing "*Clausena anisata* Hook.f." wrongly referring it to a very distinct species growing in Africa and in continental Asia, *C. anisata* (Willd.)Hook.f. ex Benth. (or, in the only possible reduced form of author's citation, *C. anisata* (Willd.)Benth.).

Although the taxonomic problem was solved, a few questions remained:

- How and when was this plant (or its ancestors) introduced from the Philippines to Indonesia?
- How and when did the particular features of cv. 'Clausanis' appear?
- Who identified it (and why) as "*Clausena anisata* Hook.f."?

Answers are given in the following history of cv. 'Clausanis'. This history is based on material evidence, collected during a long inquiry in the botanic garden libraries and herbaria of Bogor, Manila, Paris and La Réunion. But, since its origins trace back to early 19th century, it is also partly based on hypotheses, which I hope will be convincing.

2. The facts

2.1. Monsieur Perrottet's tour

On March 1820, the French botanist Eugène Perrottet left Manila with a shipment of living plants collected during a few months in the Philippines. While putting into port at La Réunion (Bourbon Island), he left part of his collections to the newly created Botanic Garden at St Denis. After a long stay (1 year) at Cayenne (French Guyana), he finally (July 1821) reached Paris and the "Jardin du Roy" (now "Jardin des Plantes"), where his numerous collections were settled in a "caldarium", or greenhouse, especially built for them (Perrottet, 1824)

Later, Perrottet drew up a list of the species he brought back, adding original descriptions for all new taxa. One of the latter is *Illicium sanki* Perr. (*Illiciaceae*), i.e. what he thought to be a new species of staranise growing near Manila (Perrottet, 1824). Actually, it was a mixture of true staranise fruit (*Illicium verum* Hook.f.) and of sterile plant of *Clausena anisum-olens* (Robinson, 1908; Smith, 1947; Molino, 1991).

2.2. In the "Jardin des Plantes", Paris

While there is no trace of this plant in earlier catalogues of the garden (all before 1821), Desfontaines described in his "*Catalogus Plantarum horti regii parisiensis*" (1829) a new species, *Cookia anisata* Desf., from a plant cultivated in the "caldarium" and native from Manila. Although no flowering part is described, the short diagnosis agrees with *C. anisum-olens*.

2.3. In the Botanic Garden, La Réunion

Richard's Catalogue (1856) first mentions by the name *Cookia anisata* (without the author's name) a tree originating from "East Indies", locally called "Anis-arbre" (i.e. anise-tree). It is absent from the preceding catalogue (Bréon, 1825).

2.4. In the Kebun Raya, Bogor

1855: First listing of a *Cookia anisata* Desf. cultivated in the garden, and "ex H.B. Bourb.", i.e. sent from the Botanic Garden at La Réunion (Teysmann & Binnendijk, 1855).

1866: *Cookia anisata* Desf. had apparently disappeared, but there is now a *Clausena anisata* Oliv. supposedly from "Afr. occ." (West Africa) (Teysmann & Binnendijk, 1866).

From successive catalogues (Hochreutiner, 1905; Boldingh, 1916; Dakkus, 1930; Setyodiwiryo, 1957; Soerohaldoko, 1963; Sastrapradja, 1973 & 1978; Danimihardja & Notodihardjo, 1985) as well as from several herbarium samples conserved in the Herbarium Bogoriense (BO) and in the Philippine National Herbarium (PNH) at Manila, I can state that trees of cv. 'Clausanis' were successively or simultaneously cultivated at different places in the garden from 1900 up to 1985 under the name *Clausena anisata* Hook.f. (or rarely *C. inaequalis* Benth.) I saw the last one still living in July 1988, but it died a few months later.

2.5. In the BALITTRO, Bogor

In 1905, the Economic Garden at Buitenzorg (now BALITTRO, Bogor) received a few seeds of unspecified origin, labelled *Clausena anisata* Hook.f. The first collection of 4 trees was slowly extended through grafting on a wild javanese relative, *C. excavata* Burm.f., but perhaps also through sexual reproduction (Wiersum, 1949).

In 1932, a Dutch agronomist, W.K. Huitema, first paid attention to this plant and started various agronomic and chemical experiments whose results were published in 1943 (Huitema and Van Heeteren, 1943), and in a scientific form, only after World War II. (Meijer, 1947; Wiersum, 1949). The essential oil from the leaves proved to consist of almost pure anethole, and was thus suggested as a possible substitute for staranise oil (Huitema and Van Heeteren, 1943; Meijer, 1947; Wiersum, 1949). These experiments were completely abandoned after 1949, but a few trees of "*Clausena anisata* Hook.f." were kept in cultivation until now.

In order to verify the botanical identity of the plant, Huitema asked for the help of the famous botanist C.G.G.J. van Steenis, then working in the Kebun Raya. Van Steenis (1932) referred to the plant as *C. anisum-olens*, but with a question mark, due to apparent contradiction between the high anethole content of its essential oil

and the results of a former study (Brooks, 1911) designating estragole as the major component (90-95 %) in the essential oil of *C. anisum-olens* (Steenis 1948). He also sent herbarium samples to the main specialists of the genus *Clausena* at the moment, Dr. T. Tanaka and Dr. Swingle, and to Kew and Paris herbaria. All this resulted in 5 different identifications (Wiersum, 1949; Steenis, 1948)!

Huitema and later Wiersum, disgusted by such a confusion, decided to keep the name in use at the Economic Garden, *C. anisata* Hook.f., as a provisional one. But they also mentioned *C. anisum-olens* as a probable identification (Huitema & Van Heeteren, 1943; Wiersum 1949). But their papers passed unnoticed of so (the second one was in Dutch), while that of Meijer (1947) got some reputation through citation in Guenther's sum on essential oils (Guenther, 1949). And unfortunately, whereas Wiersum (1949) cautiously acknowledged *C. anisata* was probably a wrong name and entitled his article "Various data concerning a possible cultivation of *Clausena*", Meijer (1947), followed by Guenther (1949), dared print "The essential oil from the leaves of *Clausena anisata* Hook.f.". Both latter authors, assuming a complete synonymy between *C. anisum-olens* and *C. anisata* (Willd.) Hook.f. ex Benth., cited pell-mell literature concerning these taxa, increasing the confusion.

2.6. Historical Record

Important dates are:

- 1799: Publication of *Amyris anisata* Willd., from a Ghanaian plant (Willdenow, 1799).
- 1824: Publication of *Elaphrium inaequeale* DC., from a South African plant (Candolle, 1824).
- 1849: The preceding taxa are transferred into the genus *Clausena*, i.e. *C. anisata* (Willd.) Hook.f. ex Benth. and *C. inaequalis* (DC.) Benth. (Hooker & Benth., 1849).
- 1861: Oliver reduced the genus *Cookia* to *Clausena* and incorrectly stated that the *C. anisata* of Hook.f. and Benth. was actually a synonym for *C. inaequalis* (DC.) Benth. He thus renamed Willdenow's taxon *C. anisata* (Willd.) Oliver (Oliver, 1861). Actually, *C. anisata* (Willd.) Hook.f. ex Benth. is the right name for Willdenow's taxon, and *C. inaequalis* is only a synonym for the same.

3. History of cv. 'Clausanis'

Although there is no material evidence of it (no type-specimens available), it seems reasonable to consider the *Illicium sanki* Perr. and *Cookia anisata* Desf. were described from the same living plant, and that this plant was a *Clausena anisum-olens* Perrottet collected in 1820 near Manila.

As far as I am aware, *Cookia anisata* is a binomial used for only 3 plants, those cultivated in 1829 in Paris, in 1855 in Bogor and in 1856 in La Réunion. So we should admit a direct relationship between these plants. A link is already clearly established between the latter two by the mention "ex H.B. Bourb." in Kebun Raya's catalogue (Teysman

& Binnendijk, 1855).

Vegetative reproduction of *Clausena anisum-olens* is very difficult (save grafting on *C. excavata*, used only since 1905 in the Economic Garden at Bogor). *Clausena* fruit are small berries containing 1 to 3 short-living seeds (they should be sown at the latest a few days after harvest). So, considering the length of maritime transports, transfer of *C. anisum-olens* in the 19th or early 20th century between botanic gardens has certainly been done by carrying living young trees born from seeds. In other words, the Bogorian plant is most probably a plant born in La Réunion from a seed produced by Richard's *Cookia anisata*.

What about the latter? It could have been either a plant directly brought by Perrottet to St Denis in 1820, or a plant born in Paris from a seed of the first "*Illicium sanki*". Indeed, Perrottet collected several individuals from each species, not only to prevent probable losses during transfer but also to leave doubles in La Réunion (Perrottet, 1824). The fact that there is no reference to such a plant in the St Denis' catalogue of 1825 (Bréon, 1825) is not really contradictory: it is a mere list of scientific names (i.e. ignoring unnamed plants of the garden), probably drawn in 1824 or early 1825 (Preface is dated March 1825). Thus Bréon (1825) was almost certainly not aware of the publication of *Illicium sanki* Perr. (1824), and couldn't have known that of *Cookia anisata* Desf. (1829). On the other hand, there was enough time between 1829 and 1855, for the first Parisian plant to fructify, for a plant of the following generation to be carried to La Réunion and to produce fruits there in his turn, and for a new tree to be sent to Bogor.

Whatever the case, I assume that the *Cookia anisata* Desf. present in 1855 in the Kebun Raya was a *C. anisum-olens* descending, through one or more generations, from a Philippinan tree collected in 1820.

The disappearing of this tree from 1866's catalogue, though troublesome, is only apparent. Indeed, we could hardly admit as purely coincidental the presence in the Kebun Raya of:

- *C. anisum-olens* before 1866 under the name *Cookia anisata*.
- true African *Clausena anisata* in 1866, disappearing before 1900.
- *C. anisum-olens* (attested by vouchers in BO) from 1900 up to 1988 under the wrong name *Clausena anisata*.

It is very much more probable that the *Cookia anisata* Desf. of 1855 was in 1866 renamed *Clausena anisata* Oliver, and thus considered as African. Oliver's work (1861), in which *Cookia* was reduced to *Clausena*, is a probable cause for this change. Authors of 1866's catalogue (Teysman & Binnendijk) evidently knew of Oliver's publication, since they used a binomial published in this work, *C. anisata* Oliver. On the contrary, they probably knew nothing of Perrottet (1824) and Desfontaines (1829), both edited in France in very few copies. Nor did they know of the true biogeographic origin of *Cookia anisata* Desf., but only of the origin of the particular Bogorian tree. It was thus logical for them to consider *Cookia anisata* Desf. as a mere synonym for *Clausena anisata* Oliv., a species they

hardly had seen.

Around 1900, trees of cv. 'Clausanis' were abundantly flowering (vouchers in BO) at the Kebun Raya, and the seeds which arrived in 1905 at the Economic Garden (which must have come from a very near source, as I stated above) certainly originated from one of them.

The morphologic anomaly of the style, present in 1900 on Bogorian trees, could have appeared on the occasion of each one of the former reproductive phases, between 1820 and 1900. As a matter of fact, all of them where probably the result of self-pollinations, individuals being isolated in gardens or if not, seldom flowering simultaneously. And autogamy, in a species for which allogamy is the rule, frequently results in malformations.

High anethole content is clearly attested only since 1932, but is probably older: collectors noted on vouchers of Kebun Raya trees in 1900 a strong smell of anise, and the tree I saw in 1988 in this garden proved, after analysis, to bear the same essential oil composition. This feature perhaps resulted also from successive self-pollinations. But it could also have already been present in a single original tree collected in the Philippines in 1820, since there is a wild "pure anethole" chemovariant.

However, we do not know the exact number of successive reproduction phases between Perrottet's tour and seeds arrival at the Economic Garden in 1905. Thus I assume that cv. 'Clausanis' apparition took place either in Paris, or La Réunion, or in the Kebun Raya at Bogor between 1820 and 1900.

4. Conclusion

During the 19th century, botanic gardens played an important rôle in plant transfer and introduction, through material exchange as well as through backing great botanical expeditions such as Perrottet's one. But this resulted sometimes in strange routes (from Manila to Bogor via Paris and La Réunion!) somewhat difficult to reconstruct, since garden catalogues were seldom explicit on geographical origins, dates of introduction, and necessarily vague on taxonomy of rare and little known plants.

Such problems can be solved only through historical inquiries using all available literature and plant vouchers in herbaria. But, as van Steenis (1948) said about Bogorian *C. anisum-olens* (cv. 'Clausanis'), satisfactory (and recent) monographs of each genus are frequently badly needed, and their absolute necessity dramatically underestimated.

Acknowledgements

This research was granted by the Centre de Recherche Pernod-Ricard (Créteil, France).

References

- Boldingh, I., 1916. Lijst der Planten gekweekt in 's Lands plantentuin te Buitenzorg. Batavia (Jakarta):123.
- Bréon, N., 1825. Catalogue des plantes cultivées au Jardin Botanique et de naturalisation de l'île Bourbon. Imprim. Gouvnt, St Denis.
- Brooks, B.T., 1911. New Philippine essential oils. Philipp.J.Sci., sect.A, 6:333-353.
- Candolle, A.-P. de, 1824. Prodrômus systematis naturalis regni vegetabilis. Paris, 1:724.
- Dakkus, P.M.W., 1930. An alphabetical list of plants cultivated in the Botanic Gardens, Buitenzorg. Archipel Drukkerij, Buitenzorg (Bogor):71.
- Danimihardja, S., and Notodihardjo, D., 1985. An alphabetical list of plants cultivated in the Hortus Botanicus Bogoriensis. LIPI, Bogor:55
- Desfontaines, R.L., 1829. Catalogus Plantarum horti regii parisiensis, 3e ed. Paris:235,406.
- Guenther, E., 1949. The Essential Oils. Vol.3 Van Nostrand, New York, Toronto, London:372-374.
- Hochreutiner, B.P.G., 1905. Catalogus Bogoriensis novo (Plantarum phanerogamarum quae in Horto Botanico Bogoriensi coluntur, herbaceis exceptis), fasc.2. Bull.Jard.Bot.Buitenzorg 19:116.
- Hooker, J.D. and Bentham, G. 1849. Flora Nigritana. in: W.J. Hooker (ed.). Niger flora. Baillière, London, Paris, Madrid:256.
- Huitema, W.K., and Van Heeteren, H.V.A., 1943. The Economic Garden at Bogor. Guide and outline of the most important plants. Bogor:19,48,51.
- Meijer, T.M., 1947. The essential oil from the leaves of *Clausena anisata* Hook.f. - Recueil des Travaux Chimiques des Pays-Bas 66:395-400.
- Molino, J.-F., 1991. Révision systématique du genre *Clausena* Burm.f.(Rutaceae). Application à la production agro-industrielle d'anéthole. Thèse de Doctorat, Univ. Montpellier-2.:97-118.
- Oliver, D., 1861. The Natural Order *Aurantiaceae*, with a synopsis of the Indian species. J. Proc.Linnean Soc. London 5, suppl.2:1-44.
- Perrottet, E., 1824. Catalogue raisonné des Plantes introduites dans les Colonies Françaises de Bourbon et de Cayenne, et de celles rapportées vivantes des mers d'Asie et de Guyane, au Jardin du Roy à Paris. Lebel, Paris. 63 pp.
- Richard, M., 1856. Catalogue du Jardin de la Réunion. St Denis.
- Robinson, C.B., 1908. Perrottet and the Philippines. Philipp.J.Sci., Botany 3:303-306.
- Sastrapradja, D.S., 1973. An alphabetical list of plant species cultivated in the Hortus Botanicus Bogoriensis. Archipel, Bogor:49.
- Sastrapradja, D.S., 1978. An alphabetical list of plant species cultivated in the Hortus Botanicus Bogoriensis. Archipel, Bogor:59.
- Setyodiwiryo, K., 1957. An alphabetical list of plant species cultivated in the Hortus Botanicus Bogoriensis. Archipel, Bogor:56.
- Smith, A.C., 1947. The families *Illiciaceae* and *Schizandraceae*. *Sargentia* 7:1-224 (*Illiciaceae*: 1-79).
- Soerohaldoko, S., 1963. An alphabetical list of plant species cultivated in the Hortus Botanicus Bogoriensis. Archipel, Bogor:59.

Steenis, C.G.G.J. van , 1948. General considerations. Flora Malesiana, ser.1, 4(1):18 (see also 4(5):590).

Teysmann, J.E., and Binnendijk, S., 1855. Catalogus van 's Lands Plantentuin. Descriptiones diagnosticae unius generis et multarum specierum incognitarum plantarum in Horto Bogoriensi coluntur. Unpubl. ms. in Herbarium Bogoriense, copy in RijksHerbarium, Leiden:178-179.

Teysmann & Binnendijk, 1866. Catalogus plantarum quae in Horto Botanico Bogoriensi coluntur (Catalogus van 's Lands Plantentuin te Buitenzorg). Ter Lands Drukkerij, Batavia (Jakarta):208.

Wiersum, L.K., 1949. Enige gegevens voor een mogelijke cultuur van Clausena. Landbouw (Buitenzorg) 21(9):445-455.

Willdenow, C.L., 1799. Linnaeus Species Plantarum, ed.4, 2:337.

IDENTIFICATION, PRESERVATION, ADAPTATION AND CULTIVATION OF SELECTED AROMATIC AND MEDICINAL PLANTS SUITABLE FOR MARGINAL LANDS OF THE MEDITERRANEAN REGION

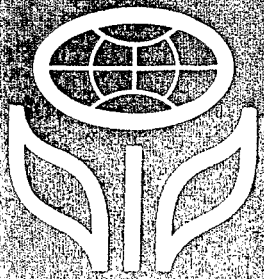
K. Panetsos, A. Nikolaidis,
G. Lyrintzis, H. Kargiolaki,
C. Fournaraki, P. Lymberakis,
and M. Skoula
Mediterranean Agronomic
Institute of Chania
P.O. Box 85, GR-73100
Chania GREECE

Abstract

Four common aromatic plants, *Salvia fruticosa* Miller, *Coridothymus capitatus* (L.) Reichenb. fil., *Satureja thymbra* (L.), *Origanum vulgare* L. ssp. *hirtum* (Link) letswart have been selected for a study on the influence of environmental and genetic factors on essential oil yield of natural populations found in Crete. Results from the first sampling (autumn) showed a great variation between populations. *Salvia fruticosa* showed an increase in essential oil yield from western to eastern longitudes, while in *Coridothymus capitatus* population growing in the Southern side were more productive than Northern, especially in Central and Eastern Crete. *Satureja thymbra* showed some populations with very high essential oil yield. The lack of correlation between the results and the environmental parameters indicates genetic differences between populations. *Origanum vulgare* was only distributed in Western Crete and showed very low essential oil yield.

1. Introduction

The highly heterogeneous soil and climatic conditions of the Mediterranean area have resulted in an increased diversity of living organisms. A great proportion of the plants residing in the area have developed their secondary metabolism towards the production of essential oils, ascribing aromatic properties to the plants. The present study investigates natural populations of some aromatic plants in the Mediterranean basin. The aim is to select plants that either produce high quantities of essential oil or have a desirable essential oil composition. After experimentation that will lead to the identification of the environmental factors that control essential oil yield and composition, the selected plants could eventually be used for cultivation in marginal lands, in order to substitute surplus crops and offer extra income to their growers.



Number 331
September 1993



I U P H A R



Acta Horticulturae

ISHS
International Society for Horticultural Science

**First World Congress on Medicinal and
Aromatic Plants for Human Welfare**

WOCMAP

**Raw Material Production
Product Introduction**

Editors
D. Palevitch
J.E. Simon
A. Mathe

**Maastricht, Netherlands
July 19 - 25, 1992**

