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Hodgsonia heteroclita (Roxb.) Hook.f. & Thomson (Cucurbitaceae) – a neglected oil plant in Southwest China

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Introduction

Hodgsonia heteroclita Hook.f. & Thomson is a traditional oil plant used in former times as Non-Wood Forest Product (NWFP) by the local ethnic communities of Southwest China (Hu 1964). In the 1960s it was identified by Chinese scientists as promising commercial oil plant due to its exceptionally high oil content in its big seeds (Hsu 1963). Cultivation trials were conducted, but interest in this perennial liana soon faded due to obstacles encountered in cultivation and management.

Changes in international market demands like the search for new products as well as the trend towards organic and biodiversity protecting farming systems with their specific requirements in management schemes made it promising to re-evaluate this species, which is largely unknown to the western world. Therefore, it was the objective of this study to compile the available knowledge about the species on the basis of a literature review and to contribute more ecological information through field research in its natural habitat in Xishuangbanna, Yunnan, PR China.

Material and Methods

Within this study all published material accessible was reviewed. Chinese publications so far practically inaccessible due to language barriers have been translated and included. The review is complimented by field observations and interviews on habitat preferences and use in Nabanhe National Nature Reserve, Xishuangbanna, Yunnan, PR China. Additionally, fruit and 'seed' characteristics as well as germination behaviour have been studied.

Results and Discussion

Hodgsonia heteroclita shows a wide distribution from southern temperate Asia (China: Guangxi, Xizang, Yunnan) to tropical Asia down to the isthmus of Kra (de Wilde & Duyfjes 2001, GRIN 2007). It is a perennial climber reaching a size of up to 30m (de Wilde & Duyfjes 2001) and showing a life span of over 70 years (Hsu 1963). The plant is dioecious, and distinguishing sexes is so far not possible until it starts to flower at the age of one (cultivated in plantation trials) to three years (forest habitats) (Wang et al. 2004). Flowering and fruit setting is strongly dependent on season and temperature, respectively. Low temperatures seriously hamper fruit setting,

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probably due to low activities of pollinating moths (Cai & Hangha 1982). Flowers open only during one night and are recorded to be pollinated mainly through *Herse convolvuli* L., although other hawk moths have been observed (own observations). Natural pollination efficiency seems very low, meaning that only few flowers are pollinated and most flowers are aborted. Artificial pollination increases fruit setting significantly (Cai & Hangha 1982).

The fruits show a unique feature in Cucurbitaceae. Usually, the family produces a specific kind of berry, a so-called 'pepo', a berry with a hard 'shell'. While *Hodgsonia* fruits resemble that fruit type at first glance (**Fig. 1**), their seeds are embedded in a stone like structure which caused some considerable discussion about its evolutionary status in the past (Roxburgh 1832, Thomson & Hooker 1853, Yang 1981). In the recent revision of *Hodgsonia* de Wilde & Duyfjes (2001) identify the structure as a pyrene, which contains 1-3 seeds, the fruit thus resembling rather a drupe than a pepo (**Fig. 2**).

Fig. 1: Fruit of *Hodgsonia heteroclita*

Fig. 2: Fruit of *Hodgsonia heteroclita* with its typical 'stones' (pyrenes)

As means of seed dispersal water has been suggested (Hu 1964). But this seems to be very unlikely taking into consideration the morphology of the fruit and the pyrenes, respectively. They neither protect the seeds nor support floating like typical water-distributed taxa as e.g. *Barringtonia* do. The pyrenes rather remind of the typical target of scatter-horderers. This is supported by interviewees from the Nabanhe National Nature Reserve near Jinghong, Xishuangbanna, as well as by Wang et al. (2004) who state that Dai people call it "Majing", meaning something like 'favourite squirrel food'.

An ecologically very important feature is the symbiosis between the plant and the weaver ant *Oecophylla smaragdina*. According to Kazuki et al. (2004) the ant species is the oldest documented biological pest control agent in human history. *Hodgsonia* shows specific morphological adaptations to support the ant species. Extrafloral nectaries can be found on flowers, fruits, lower leaf surfaces and especially in the axils of shoots (**Fig. 3 and 4**). *Oecophylla smaragdina* seems to provide very efficient protection as has been documented by Kazuki et al. (2004) and could be confirmed by own observations.

Fig. 3: *Oecophylla smaragdina* on young male flowers; glands are clearly visible

Fig. 4: *Oecophylla smaragdina* on specific extrafloral nectarines at nodes

Economically, the outstanding feature of *Hodgsonia* is the nutritional value of its seeds. They show a very high seed-oil content between 72% and 77% (Cai 1963), high degrees of unsaturated fatty acids, as well as proteins. They are also reported to have a very pleasant taste (Wang et al. 2004, own interviews). During the interviews several people from the Nabanhe National Nature Reserve stated that the seeds should not be eaten raw due to negative health effects, but no analysis could be found dealing with toxicity of the plants.

Due to the promising features of the seeds the plant was strongly promoted in the 1970th, resulting in research on propagation, cultivation and management (Hsu 1963, Cai 1963, Wang et al. 2004). Propagation with 'seeds' (actually pyrenes containing 1-3 seeds) does not encounter problems (own observations). But due to the dioecious habit it may take until first flower setting - after 1-3 years - to discover if a plant is male or female and thus if it produces fruits or not. This is unwanted in a plantation scheme. Therefore, vegetative propagation was tested using cuttings and layering, the latter providing the best results. Plants can start flowering and fruiting after one year. Fruit setting, and thus harvest, is not continuous but depends on weather conditions during the flowering period. One plant can provide about 2,5 liters (up to 10?) of oil per year. A key issue in the management of the species is the processing of the fruit and seeds, respectively. The seeds are embedded -usually as twos- in a stone-like structure ('pyrene') within the fruit, making the extraction of the seeds laborious and thus expensive. Despite the promising features of the plant product, the oil, the interest in the species decreased quickly, and no subsequent research could be identified.

Discussion

As is typical with many of the so-called NTFP the available knowledge about the species is astonishingly poor and fragmentary, as can be seen from data about the toxicity of the seeds. Research on the species has been conducted during a very short period, especially in the 1970th. Since then the species practically got forgotten. Since publications from that time are often anecdotal the results are difficult to evaluate. It seems that many institutions were involved in the study and promotion of *Hodgsonia heteroclita* at that time. But only few data made their way into still accessible publications. Much of the gathered experiences might still be hidden in reports.

Especially in the light of globalization with its changing marked demands and the trend towards organic and biodiversity promoting farming the plant's favourable characteristics make a new approach to manage it worthwhile. The oil might be an interesting product fitting in the modern market environment, e.g. as cooking oil or for cosmetics. The seeds also seem to have promising properties, e.g. as snack. But this will require a sound analysis of its chemistry and

especially its potential toxicity. As a perennial, woody liana, that can obtain a considerable age and also does not seem to be very demanding (Tan et al. 1965), it would ideally fit into an analogue agroforestry system as e.g. 'rainforestation'. Additionally, its distinct ant-plant association with the Asian weaver ant *Oecophylla smaragdina*, which is well known for its outstanding predatory power and provides a natural pest protection, would support its application in organic farming.

References

Cai Xitao & Hangha 1982. A Study on the Causes to Prematurely Dropping of Fruit, *Hodgsonia macrocarpa*, Collected Research Papers on the Tropical Botany (Chinesisch)

Cai, Huiyuan 1963. The Nutritious Ingredients of *Hodgsonia macrocarpa* - A New Oil Plant. Science Bulletin (2):64-65.

GRIN 2007. *Hodgsonia heteroclita* information from NPGS/GRIN. Germplasm Resources Information Network (GRIN), United States Department of Agriculture.
http://ars-grin.gov/cgi-bin/npgs/html/taxon.pl?19186
Acces: 03.10.2007.

Hooker, J.D. & Thomson, T. 1853. On *Hodgsonia*, Hook.fil. et Thoms., a new and remarkable genus of Cucurbitaceae. Proceedings of the Linnean Society 2: 257-259.

HSU , CHIEN 1963. "Lard fruit" domesticated in China. Euphytica 12: 261-262.
Hu, Shiu-Ying 1964. The Economic Botany of *Hodgsonia*. Economic Botany 18: 167-179.

Kazuki, Tsuji; Hasym, Ahsol; Harlion & Nakamura, Koji 2004. Asian weaver ants, *Oecophylla smaragdina*, and their repelling of pollinators. Ecological Research 19: 669–673.

Roxburgh, W. 1832. Flora Indica, Descriptions of Indian Plants 3: 705-707.

Tan, Bogen; Jiang, Guoxian, Yuan, Ruidong 1965. Further Report on the Biology of *Hodgsonia macrocarpa*. South China Institute of Botany/South China Botanical Garden Vol.4, No.3.

Wang, Yu Ning; Cai, Li; Wang, Zhen Huai 2004. Story of Lard Fruit (*Hodgsonia macrocarpa*). Books about the sacred sites of Chinese Academy of Science, Xishuangbanna Tropical Botanical Garden, Mr. Cai Xitao and the world known garden. Hebei University Press, Baoding, 173-182 (Chinesisch).
Wilde, de W.J.J.O. & Duyfjes, B.E.E. 2001. Taxonomy of *Hodgsonia* (Cucurbitaceae) with a Note on the Ovules and Seeds. Blumea 46: 169-179.

Yang, Shinhua 1981. A preliminary study on the structure of seed shells and fruit coats in *Hodgsonia macrocarpa* Cogn. Acta Botanica Yunnanica 3(2): 203-207.