

Kiwifruit (*Actinidia deliciosa* LIANG & FERGUSON) occurring in the wild in western Germany

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Kurzfassung

Wildwachsende Exemplare der Kiwifrukt *Actinidia deliciosa* LIANG & FERGUSON, einer verholzenden Liane, wurden an zwei Fundorten in Nordrhein-Westfalen (Erstfund, 1998) und Hessen nachgewiesen. Es handelt sich um Einzelpflanzen, die an mikroklimatisch günstigen Standorten bereits mehrere Winter überstanden haben, aber noch nicht zur Blüte gelangt sind. Ähnliche Vorkommen gibt es in jüngster Zeit auch in anderen Ländern Europas. Hinweise zur Unterscheidung der nahe verwandten Sippen *A. deliciosa* und *A. chinensis* PLANCH. in vegetativem Zustand werden gegeben. Die Möglichkeiten der Ausbreitung werden im Vergleich mit den ähnlichen Fällen *Lycopersicon esculentum* und *Physalis peruviana* diskutiert.

Abstract

Single plants of kiwifruit, *Actinidia deliciosa* LIANG & FERGUSON, a woody liana, have been found growing in the wild at two places in Northrhine-Westphalia (first record, 1998) and Hesse. The plants survived several winters at sites which are favourable with regard to the microclimate, but they have not yet reached flowering age. In recent years, similar occurrences were observed in other European countries. Hints are given on the distinctive characters of the closely related taxa *A. deliciosa* and *A. chinensis* PLANCH. in the vegetative state. Mechanisms of spreading are discussed in comparison to the similar cases *Lycopersicon esculentum* and *Physalis peruviana*.

Keywords

Actinidia, neophytes, alien species, casual alien plants, Northrhine-Westphalia, Hesse

Nomenclature

WISSKIRCHEN & HAEUPLER 1998 (exception: *Actinidia* spp.)

1 Introduction

In August 1998, while investigating the riparian flora in the catchment area of the river Rur (Northrhine-Westphalia), the author found a single kiwifruit plant growing in the wild.

Since then, the place in question has been revisited several times (last time in September

2001), the occurrence being confirmed every time. In the year 2000, Mr. Dietmar Teuber, Giessen, found a wild kiwifruit plant by the side of a forest path in southern Hesse. Thereby, doubt was cast upon the initial assumption of an insignificant, isolated case. The extensive import as fruit, the increasing use as a garden plant, and the conceivable breeding of hardier forms might make a future increase of wild occurrences of kiwifruit possible. This is an occasion to report details about the records and the taxonomic identity of the plants.

2 Locations and site characteristics

Location 1: State of Northrhine-Westphalia, landscape unit Vennvorland, grid square 5203/144: Stolberg-Binsfeldhammer, right bank of the Vichtbach stream under the bridge of road L 238, 190 m a. s. l.; August 11, 1998, herbarium G.K. 98-133; again in following years (last visit: September 19, 2001).

One plant is growing on a half-shaded site under the southwestern side of a road bridge crossing the Vichtbach. Here, along the concrete wall of the bridge's duct, the stream has deposited a narrow strip of gravel, which rises only slightly above the mean water level, and which is vegetated loosely by, among others, several woody plants (*Fraxinus excelsior*, *Sambucus nigra*, *Clematis vitalba*; fig. 1). The bank of the adjoining upstream section is in full light, and is densely vegetated by *Petasites hybridus*, *Phalaris arundinacea*, *Stellaria aquatica*, *Impatiens glandulifera*, *Urtica dioica* and *Eupatorium cannabinum*; there, in a relevé of 100 square meters, 49 species were recorded. The place where the *Actinidia* plant is growing can only be reached at normal water-level when wading some meters upstream under the bridge. Furthermore, left-overs of fruits which might be thrown away by passers-by on the bridge cannot reach this place directly. Thus, washing ashore of seeds by the running water must be assumed.

Location 2: State of Hesse, landscape unit Vorderer Odenwald, grid square 6217 /444: South of Hochstädten, northwest of the "Ludwigshöhe", east-southeast of the marble works: in northeastern exposition on the embankment of a small forest road leading from the marble works upwards toward Ludwigshöhe, a little bit above the old quarry, 230 m a. s. l. (Gauss-Krüger grid values: R 3474960, H 5507840); September 27, 2002, herbarium G.K. 02-172.

This occurrence, discovered by Dietmar Teuber on September 14, 2000, was confirmed by the author in the year 2002: a single plant with several strong shoots was registered on the embankment of the forest road in a half-shadow to full-shadow situation, growing between

moderately dense shoots of *Rubus* (fig. 2). The base part is lying on the ground for a length of about 1-2 m. Several winding shoots interweave the surrounding vegetation, the most vigorous one reaching a height of 2 m above ground by climbing in a young ash tree (*Fraxinus excelsior*). Furthermore, the plant is associated with *Athyrium filix-femina*, *Hedera helix*, *Oxalis acetosella*, *Stachys sylvatica*, *Eupatorium cannabinum* and *Geranium robertianum* on this site. Most likely, seeds of kiwifruit could have reached the place, which is pretty far from human settlements, with discarded left-overs of fruit.

3 Taxonomy

The genus *Actinidia* comprises about 50 eastern and southern asiatic species; in Europe, about five to ten species are cultivated (FERGUSON & NELSON 1995), partly because of the decorative appearance of their foliage and their climbing habit, partly because of their fruit. The species which is cultivated on a commercial scale as a fruit plant (kiwifruit) in many countries is *Actinidia deliciosa* LIANG & FERGUSON; it is a woody liana which can reach an age of more than 50 years, and is native to China. Nevertheless, for a long time, New Zealand has been the world's largest producer of kiwifruit. Breeding and cultivation activities in New Zealand during the 20th century have helped this fruit plant on the road to success (FERGUSON 1984, KNÜBEL 1985, FRANKE 1997). About 1960, the name kiwifruit, which is nowadays in common use, and which often is abbreviated to kiwi, was derived from the heraldic bird of New Zealand, the kiwi; this was done for marketing reasons (FERGUSON 1984). In Europe, commercial cultivation on a wide scale only began in the last century's seventies (MORTON 1987); nowadays, Italy is the world's largest producer of kiwifruit.

Actinidia deliciosa, described in 1984 by Liang & Ferguson, is hexaploid. Initially it was regarded a variety of *A. chinensis* (*A. chinensis* PLANCH. var. *hispida* LIANG), a species which is either diploid or tetraploid (Ferguson, pers. comm.). Both are included in section *Stellatae* LI, whose members are characterized by soft stellate hairs on leaves and twigs. Even in recent times, some authors did not distinguish between the two taxa (cf. FITSCHEN 1990, ROLOFF & BÄRTELS 1996). Meanwhile, *A. chinensis* in the narrow sense is cultivated in Europe, too, but it is supposed that this species came into use here considerably later than *A. deliciosa*, namely, not earlier than in the course of the 1980s (FERGUSON & NELSON 1995). The morphological distinction of both species is done most simply by using the form and indumentum of the fruit as characters, with the fruits of *A. deliciosa* being more oblong and more hairy.

However, escaped plants in Germany have only been found in a vegetative state. With support from Mr. Ross Ferguson (Auckland, New Zealand), who sent herbarium specimens for comparison and who gave expert advice about photographs of the plant growing on the bank of the Vichtbach, the identification as *Actinidia deliciosa* was possible. The following comparison in tabular form is giving hints on the distinction of the two taxa with characters of leaves and twigs (tab. 1).

On the basis of vegetative characters alone, the determination of these taxa is rather difficult if there is no material for comparison at hand. Leaf shapes show a pronounced variability; especially the leaves on young shoots are often very different in shape from those on flowering shoots (Ferguson 1984, and pers. comm.; own observ.). This can make the evaluation of herbarium material more difficult. In the vegetative state, over-wintering buds are the most useful character for separation (Ferguson, pers. comm.). Though, in case of herbarium material including only the youngest, hardly lignified sections of shoots, this criterion is not applicable.

The indumentum of shoots offers important characters (cf. fig. 3). Both taxa have a range of different types of hairs: long, pointed, more or less rufous hairs; very short whitish papillae-like hairs having rather obtuse tips (the latter type is only visible properly with a magnification of 20 times or more); and hairs of intermediate size. The species differ from each other not only in the different density of the indumentum, but also by the fact that almost all of the pointed hairs in *A. deliciosa* are of equal length, whereas in *A. chinensis* shorter and mostly paler, pointed hairs are numerous, too. A conspicuous, particularly dense, rufous indumentum is typical in *A. deliciosa* for the youngest parts of vigorous shoots (FERGUSON 1984:18); this indumentum covers shoots, petioles and upper sides of leaves.

Drawings of leafy twigs and fruits of both taxa were published by LIANG (1984), and drawings of leafy twigs in flower by LIANG (1975), with *Actinidia deliciosa* being named *A. chinensis* var. *hispida*. A photograph of leafless shoots in SHIM et al. (1998) is showing the differences in indumentum in macroscopic view.

4 Discussion

Before the findings reported here, no occurrences of *Actinidia* taxa in the wild in Germany were known. In recent years, there have been reports on casual adventitious occurrences from other European countries. From Italy, the leading producer country, records are known from the northern part, there, for example, several times on railway ground

(GIORDANA pers. comm., POLDINI et al. 2001), and from Central Italy (CELESTI GRAPOW 1995:189, CELESTI GRAPOW et al. 2001:326). In Belgium, three occurrences on wall sites were reported (VERLOOVE 2002). In England, a case of spontaneous arrival of *A. deliciosa* was observed in a garden in which this species had never been cultivated (PAYNE 1997); in the second year, this plant reached a height of 3 meters. All these reported cases concern young plants without flowers or fruits.

In cultivation, kiwifruit plants start flowering and fruiting only after 5-10 years; for occurrences in the wild, similar periods of time must be assumed. The two reported occurrences in western Germany, like the occurrences in other parts of Europe known until now, must be classified as casual for the time being, although even now the plants are several years old.

Inferred from the demand for warmer climate that is often supposed for *Actinidia deliciosa*, the ability to thrive should be expected only in the warmest regions of Germany. Both of the growing sites described here are situated in border zones of low mountain ranges. This means, they do lie near regions that are favoured by a comparably warm climate, but in fact are situated a little bit outside of these regions (Niederrheinische Bucht, Oberrheingraben). It can not be predicted if the plants will thrive here permanently. Favourable, in any case, is the microclimatic situation of both growing sites, which is influenced by the bridge construction above the stream (site 1), and by the northeasterly directed slope within the forest stand respectively (site 2). The growing sites are thereby protected from excessive levels of irradiation of thermal energy at night time. For air moisture, values above average can be supposed. This shows some parallels to site characteristics in the native distribution area in China: the factor air moisture is important for *Actinidia deliciosa* there, too (cf. FERGUSON 1984:12). In other words, the comparably high sensitivity to low winter temperatures is by far not the only factor that could hinder occurrences of this species in Germany.

Presumably, the dispersal of the seeds of *Actinidia deliciosa* is effected in similar ways as in tomato (*Lycopersicon esculentum*) and cape-gooseberry (*Physalis peruviana*) - two useful plant species which form casual wild occurrences very regularly in more or less extensive parts of Germany (KÖNIG 1989, ADOLPHI 1995, and own observations). Like tomato and cape-gooseberry, the kiwifruit contains very numerous small seeds in its pulp, which can reach the open landscape with food left-overs or insufficiently purified sewage. Because of these mechanisms of dispersal, margins of roads and paths, waste disposal sites and river banks are the preferred growing sites of the species mentioned. As for the tomato plants casually growing in the wild, it can not be stated for *A. deliciosa* if the wild occurrences were founded by seeds from imported fruit, or by seeds from plants cultivated

in Germany. Since harvest-yields in Germany are comparably low, the former alternative seems to have a higher probability.

Seeds from the fruits of *Actinidia* plants cultivated in private gardens in different parts of Germany are reported to germinate readily if fruits that have fallen down or have been thrown away are deposited on compost heaps or garden soil (pers. comm. from Dr. G. Brilla: Bonn; Dr. H. Haeupler: Bochum; and Dr. C. Mückschel: Weilburg on Lahn river). The germination ability of seeds in commercially imported fruits of *Actinidia deliciosa* is very high. The author carried out own experiments with dried seeds from fruits of two different origins in Italy, each with two approaches: without stratification, and with stratification through storage at temperatures below freezing point for several days respectively. In Petri dishes lined with filter paper, which was kept constantly moist, germination rates after three weeks were higher than 70 % in all approaches (tab. 2). Stratification did not show an influence on the rates of germination.

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Fig. 1:

Actinidia deliciosa at location 1 (Stolberg-Binsfeldhammer, Northrhine-Westphalia), under a road bridge crossing the Vichtbach, September 19, 2001; at this site, the plant was first discovered in 1998.

Fig. 2:

Actinidia deliciosa at location 2 (near Hochstädten, Hesse), on the embankment of a small forest road; one of its shoots is winding in a young ash tree, September 27, 2002.

Fig. 3:

Young shoots of *Actinidia deliciosa* (left) and *Actinidia chinensis* (right) showing the differences in the indumentum. (*A. deliciosa*: collected at location 1, August 11, 1998, herbarium G. K. 98-133; *A. chinensis*: cultivated material from New Zealand, herbarium G. K. 02-004).

Tab. 1:

Vegetative characters of *Actinidia deliciosa* and *A. chinensis* (after FERGUSON 1984 & pers. comm., SHIM et al. 1998, modified according to own observations).

Tab. 2:

Germination of seeds of *Actinidia deliciosa* ; for the germination experiments, commercially imported fruits from Italy have been used (see text for further details).

Tab. 1

	<i>A. deliciosa</i>	<i>A. chinensis</i>
shoot hairiness	quite hairy; the pointed, coloured hairs are very long (as long as the young shoot tip's diameter), and rather stiff <i>viewed with a strong lense or binocular:</i> <i>the difference in size between the two types of hairs is extreme: most minute pale hairs are shorter than the width of the long coloured hairs' bases</i>	with much finer hairs: the coloured hairs are short (shorter than the young shoot tip's diameter) and softer <i>the difference in size between the two types of hairs is rather small: minute pale hairs are often longer than the width of the long coloured hairs' bases; the length of the long pointed hairs is rather variable, some of them are only slightly longer than the minute pale hairs, many of them are intermediate</i>
over-wintering buds	almost completely submerged in the bark of the leaf axil	more or less obvious and protuberant, not buried in the bark
leaf size	rather large	rather small
young shoots' leaf shape	more pointed and more coarsely toothed	more rounded
young shoots' leaf colour	greener, or, particularly earlier in the season, with strong red pigmentation	characteristically more olive-brown than green

Tab. 2

	seeds germinated after 2 weeks (%)	seeds germinated after 3 weeks (%)	seeds not germinated within 3 weeks (%)	<i>sample size</i> <i>(total number</i> <i>of seeds)</i>
	not stratified			
Origin 1 (cultivar "Hayward")	20	75	25	339
Origin 2 (cultivar not indicated)	20	76	24	133
	stratified			
Origin 1 (cultivar "Hayward")	22	81	19	404
Origin 2 (cultivar not indicated)	18	81	19	201