***Trachycarpus fortunei*** **System:** Terrestrial

| Kingdom | Phylum | Class | Order | Family |
|---|---|---|---|---|
| Plantae | Magnoliophyta | Liliopsida | Arecales | Arecaceae |

**Common name** hemp palm (English), Chinese fan palm (English), windmill palm (English), Chinese windmill palm (English), palma de jardín (Spanish), hochstämmige Hanfpalme (German), palmier de Chine (French), chusan palm (English), palmeira-moinho-de-vento-da-China (Portuguese, Brazil)

**Synonym** *Chamaerops fortunei*
*Trachycarpus caespitosus*
*Trachycarpus wagnerianus*
*Chamaerops excesla*
*Trachycarpus excelsa*

**Similar species** *Trachycarpus martianus, Trachycarpus takil, Trachycarpus wagnerianus*

**Summary** Trachycarpus fortunei, commonly known as the Chinese windmill palm, is an evergreen palm that is primarily cultivated for ornamental purposes. Recognisable by its large, fan-shaped leaves, it can grow in varied climates - from warm-temperate to sub-tropical. It is one of the cold-hardiest palm species. This temperature sensitivity has allowed T. fortunei to be used as a bioindicator for tracking climate change, as recent range increases correlate with climactic warming. Seeds are spread by birds, and plants are frequently documented as escaped from cultivation. However, seedlings are climatically more sensitive than adult palms and thus seedlings are not always successful in establishing, particularly in areas at the edge of the plant's distribution. Invaded environments include fragmented and natural forests, disturbed areas, riparian zones, shrub and scrublands, urban areas and wetlands.

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**Species Description**
Trachycarpus fortunei is a dioecious, evergreen palm that can grow up to 15 m. Leaves are large (up to 1 m), distinctive and fan-shaped (1 m) from a sharply toothed petiole, which to around 1 m long, and even longer in shady areas.The trunk is straight, solitary and fibrous, and dead leaves hang from the top forming a skirt - however, the plant does not produce a trunk when it is small. Male flowers (yellow) and female flowers (greenish) grow on separate plants on large, branched and drooping spikes, followed by fruit that ripens to from green to blue-black. Fruit is kidney-shaped and 10-12 mm long (ARC 2008; Gibbons 2003; Koike 2006; Weedbusters 2010; Windsor-Collins *et al*. 2006).

**Notes**
Species interactions: In New Zealand *Trachycarpus fortunei* has recently been identified as major food source for the lesser short-tailed bat (*Mystacina tuberculata*). Flowers from just four plant groups appear to be regularly used by this endemic bat species: *Collospermum* spp., *Knightia excels*, *Metrosideros* spp. and apparently, *T. fortune*. The pollen of the exotic palm amounts to up to 57% of the analyzed diet (Peterson *et al*. 2006).\r\n
Climate change: While *T. fortunei* is native to sub-tropical China (along with Myanmar and the Himalayas), it is one of the most cold-hardy palms. *T. fortunei* is thus cultivated as an ornamental in many countries and its cold-tolerance is well documented (Caramyshev *et al.* 2006; Essig & Dong 1987; Koike 2006; Khurram & Miyamoto 2005; Walther & Berger 2007). Outside of its native range, *T. fortunei* has established itself in Australia, Japan, New Zealand, Spain, the United States, and more recently, Switzerland (Armengol *et al.* 2005; GCW 2007; USDA-ARS 2010; Hodel *et al.* 2006; Walther 2003). \r\n
The establishment of *T. fortunei* in the south of Switzerland is further north than the previous northernmost palm population in Europe, and exists outside the usual latitude range for palms (Walther *et al.* 2007). It is thought that this invasion and range expansion of *T. fortunei* may be being aided by climate change effects; in this case milder winter conditions. Research has linked the effects of climate change with an increase in survival of species outside their normal ranges (e.g. Berger *et al.* 2007; Niinemets & Peñuelas 2008; Pyšek *et al.* 2003; Van der Veken *et al.* 2007; Walther *et al*. 2009). This can be most easily seen in places of higher latitude and altitude where temperature previously constrained the survival of thermophilous species such as *T. fortunei* (Walther *et al.* 2009). \r\n
Palms have long been recognised as bioindicators for warm climates in palaeontology (Walther *et al.* 2007). While the range expansion of *T. fortunei* in Europe had been previously noted, in 2007 Walther *et al.* investigated the climactic factors underlying this expansion. Using information on conditions of actual and modelled data of the native and introduced ranges of *T. fortunei*, a larger picture was built of climactic constraints on *T. fortunei* establishment and growth. This enabled the authors to determine whether establishment of populations in southern Switzerland were a function of changing climactic conditions or due to chorological causes, such as increased availability of seed sources. \r\n
Examination of meteorological data in the native range in China and in Switzerland gave a minimum average temperature of 2.2°C of the coldest month as a threshold for seedling survival and successful growth to maturity. Viewing the mean monthly temperature data for Switzerland from 1864 – 2008 showed a marked increase in favourable conditions since the 1950s. Continuously favourable conditions in terms of temperature and length of the growing season have occurred since the 1970s (Walther & Berger 2007) which is correlated with the establishment of wild *T. fortunei* populations in this area over the past few decades. \r\n
Based on this temperature threshold, other areas in Europe that were previously unsuitable for palms may have appropriate climactic conditions to support the growth and establishment of seedlings (Walther & Berger 2007). It is extrapolated that new areas of the world will become increasingly suitable for *T. fortunei* survival under current climactic trends. This will likely continue the expansion in range of *T. fortunei*, as in southern Switzerland (Walther *et al.* 2007). *T. fortunei* and other palms may therefore be good bioindicators for climactic changes occurring globally.

**Uses**
Uses are primarily ornamental and medicinal (USDA-ARS 2010), *T. fortunei* is also used as food for both humans (flowers) and animals (seeds), in construction (house pillars, thatched roofs), and the fibre can be used to make a variety of products, including ropes, mats and furniture (Essig & Dong 1987). Wax can be derived from the fruit exterior, which can be used to make polishes, wax paper and carbon paper, among others (Essig & Dong 1987).

**Habitat Description**
*Trachycarpus fortunei* is a warm-temperate palm (Taylor *et al.* 2000), but is widely grown in warm-temperate and sub-tropical regions (Essig & Dong 1987). *T. fortunei* appears tolerant to cold, frost, seaspray and wind (Caramyshev *et al.* 2006; Sydney Water 2010). It is thought that limiting factors for establishment of *T. fortunei* are precipitation in warm-temperate and subtropical areas, and minimum winter temperature and growing season length towards the poles (Berger & Walther 2006; Walther & Berger 2007; Walther *et al.* 2007).

**Reproduction**
*Trachycarpus fortunei* only reproduces by seed. While normally dieocious, individual trees have been shown to sometimes grow both male and female flowers. Flowers are grown on large, branched, drooping spikes during summer, and are then followed by small kidney-shaped fruit (10 - 12 mm) that ripen from green to blue-black during autumn. *T. fortunei* produces prolific seed, which is dispersed by birds, wind and gravity (Koike 2006; Li *et al.* 2006; Weedbusters 2010).

**General Impacts**
*Trachycarpus fortune* competes with native edge and understory species. *T. Fortune* can persist for many years in the understory, where leaves cast shade on other seedlings and saplings, competing with native understory species. It may also form dense stands before a thinning process works when it grows up (Ishii & Iwasaki 2008; ARC 2008).

**Management Info**
The implications of management measures for organisms other than the target species should carefully be considered. In case of *Trachycarpus fortunei* in New Zealand, removing *T. fortunei* implies the removal of the provider of a large portion of the diet of the vulnerable native lesser short-tailed bat, *Mystacina tuberculata* (Peterson *et al*. 2006).\r\n\r\n
The spread of *T. fortunei* can be controlled by cutting the frutescence before seeds have ripened, physically removing plants, by digging out small individuals and seedlings and felling larger ones. This can then be followed up with treatment using herbicides. However, from a certain stem height the palm is no longer able to resprout, thus herbicide application is not necessary (G.-R. Walther, pers. comm.). It is recommended that sites be monitored and any seedlings or regrowth be treated (Ishii & Iwasaki 2008; Weedbusters 2010). \r\n
There are implications for management regarding the effects of climatic change, as new areas become suitable for invasion by species that were previously constrained by factors such as temperature. These invasions will change the composition of habitats and the functioning of ecosystems on both the macro- and microorganism level (Walther *et al*. 2009). The formation and potential importance of non-analogue communities as a consequence of the development of non-analogue climates with global warming should be considered in the context of management options (Walther 2010).

**Pathway**
(Walther 2003)

**Principal source:**

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**Review:** Gian-Reto Walther, Department of Plant Ecology, University of Bayreuth, Germany

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**ALIEN RANGE**

**[6]** AUSTRALIA
**[1]** CHILE
**[1]** FRANCE
**[1]** ITALY
**[5]** NEW ZEALAND
**[1]** SWITZERLAND
**[1]** UNITED KINGDOM
**[1]** CANADA
**[1]** ECUADOR
**[1]** HONG KONG
**[3]** JAPAN
**[1]** SPAIN
**[1]** TURKEY
**[1]** UNITED STATES

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