Recurved phyllaries of Taraxacum function as a floral defense : experimental evidence and its implication on the evolutionary history of Taraxacum

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Recurved phyllaries of *Taraxacum* function as a floral defense: experimental evidence and its implication on the evolutionary history of *Taraxacum*

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Abstract

Florivores directly decrease reproductive success of plants by consuming pollen and seeds, and thus plants often have some defense mechanisms against florivory. Here, I show that recurved phyllaries of an agamospermous hybrid dandelion *Taraxacum japonicum x officinale* function as a physical barrier to florivory by slugs. I allowed *Lehmannia valentiana* an European slug naturalized in Japan to feed on eight pairs of the hybrid dandelion and *T. japonicum*, a Japanese species having erect phyllaries. Consequently, slugs damaged flowers only of *T. platycarpum*. Slugs moved back from recurved phyllaries or spent more than two times longer on recurved phyllaries than on erect phyllaries. When recurved phyllaries were experimentally removed, slugs spent on phyllaries of the hybrid as long as on phyllaries of *T. japonicum*. In addition to recurved outer phyllaries, the hybrid dandelion has erect inner phyllaries longer than those of *T. japonicum* that effectively concealed florets at night and protected them from florivory by slugs. Using taxonomic literature, I confirmed that recurved phyllaries evolved in many sections and species of Europe but rare in East Asia. These findings suggest that European dandelions acquired recurved phyllaries as a defense mechanism under antagonistic coevolution with florivorous slugs but this coevolution did not occur in East Asia.

Key words Alien species - Dandelion - Florivory - Reproductive success - Slug

Introduction

Not only leaves and shoots but also flowers are damaged by many herbivorous animals. Compared to herbivory of vegetative organs, florivory can influence plant fitness more directly by reducing seed production. However, much less attention had been paid to florivory until McCall and Irvin (2006) published a seminal paper on this phenomenon. Since then, there have been a growing body of studies on its effects on fitness (Cardel and Koptur 2010; Ferreira and Torezan-Silingardi 2013) and its influence on the evolution of plant traits including plant defense strategy (Theis and Adler 2012; Kessler et al. 2013) and plant mating system (Penet et al. 2009).

Plants can protect reproductive tissues against florivory through direct and indirect defense mechanisms. First, plants can accumulate higher concentration of secondary compounds in reproductive tissue (Adler et al. 2001). Second, plants could change the time of flowering to escape from florivores (Breedlove and Ehrlich,1968). Third, physical barriers, such as trichomes, could limit florivore’s access to reproductive tissue (McCall and Irvin 2006). Nyctinasty, the sleep movement of flowers, provides another example of a physical barrier that can help protecting reproductive tissue at night (McCall and Irwin 2006). Fourth, indirect resistance is provided by mutualistic interaction with animals that are predatory on florivores (Horvitz and Schemske 1984). Among those mechanisms, physical barriers to florivory remain poorly understood in spite that those are effective against leaf and shoot herbivores (Textor and Gershenzon 2009; Schaffner et al.

2011; Yamawo and Hada 2010).

Here, I show that recurved phyllaries of dandelions function as a physical barrier to florivory by slugs. European dandelions and slugs are naturalized in Japan and provide an extraordinary opportunity for testing the function of recurved phyllaries as a physical barrier to florivory because I can compare feeding damage between European and Japanese dandelions with and without recurved phyllaries. An European dandelion, *Taraxacum officinale*, was introduced from Europe to Japan around 1900 (Makino 1904) and became common until 1985 (Ogawa and Mototani 1985). Recently, it has been reported that hybrids of *T. officinale* with native congeners, *T. japonicum* and *T. platycarpum*, are common in urbanized areas and bare lands of Japan (Yamano et al. 2002, 2004). Those hybrids produce abundant fertile seeds by agamospermy and are now widespread in Japan (Mitsuyuki et al. 2014). *T. officinale* and the hybrids are often difficult to be distinguished morphologically because both have recurved outer phyllaries and longer inner phyllaries that are key traits to distinguish exotic dandelions from the native species of Japan, Taiwan and Korea (Ogawa 2002).

A nocturnal terrestrial slug *Lehmannia valentiana* is originally native of the Iberian Peninsula and Balaeric Islands in Europe, and naturalized in various countries of North and South America, Africa, Oceania, and Asia (Waldén 1961; Forsyth 2001). In Japan, this species was first recorded in

1950s and then became common until 2000s (Kurozumi 2002; Udaka and Numata 2010). This slug threatens agricultural production of fruits and vegetables in Japan. In Fukuoka City locating in western Japan, I found many exotic slugs moved toward the capitula of native T. *japonicum* and fed on them in 2011 and 2012, but dandelions with recurved outer phyllaries (European dandelions or the hybrids) were immune. I hypothesized that the differences in floral morphology between alien and native dandelion species might be associated with the differences in the degree of capitula damage from exotic slugs.

In this paper, I first experimentally show that a slug Lehmannia valentiana naturalized in Japan gives serious damage to flowers of *T. japonicum* but no damage to flowers of the hybrids. Second, we experimentally show that recurved phyllaries of the hybrid dandelions are effective to reduce attacks of the slug to dandelion flowers. Third, we show that recurved phyllaries are common in dandelions of Europe and West Asia, but uncommon in East Asia where *Lehmannia valentiana* is not native. The purpose of this paper is to report these findings and discuss about their implications on a function of recurved phyllaries in *Taraxacum* and evolutionary history of *Taraxacum*.

Materials and Methods

Study species

Taraxacum japonicum is a perennial herb native to western Japan, inhabiting open places. This diploid species is self-incompatible and reproduces sexually (Morita et al. 1990). In Fukuoka City where I made my study, *T. japonicum* usually flowers from mid March to early June, having relatively smaller flower heads (27.8 mm in average diameter) with light yellow petals.

Populations of *T. officinale* naturalized in Japan are known to be triploids (Ogawa and Mototani 1985) and reproduce by agamospermy (Asker and Jerling 1992). *T. japonicum* x *officinale,* the natural hybrids between triploid *T. officinale* and native sexual *T. japonicum* are triploids or tetraploids, and reproduce also by agamospermy (Hoya et al. 2004). Those are widespread in open habitats and now one of the most common dandelions in Japan (Yamano et al. 2002, 2004). In morphology, the hybrids having recurved phyllaries are very similar to *T. officinale* and usually a genotyping by molecular markers is the only way to distinguish the hybrids from *T. officinale* (Shibaike 2005). According to Yamano (2004), proportions of the hybrids among dandelions with recurved phyllaries amounted from 80 to 98 % in five areas of Honshu, Japan. In the populations I studied, I could not find *T. officinale* and thus I used the hybrids for my experiments.

I sampled dandelions in May 2011 at three sites; Ohori Park, Fukuoka City, Fukuoka

Prefecture (33°35'17.9"N 130°22'48.1"E) and Mikiyama Park, Kobe City, Hyogo Prefecture (34°47'18.6"N 134°59'20.1"E) for *T. japonicum*, and the Hakozaki campus of Kyushu University, Fukuoka City, Fukuoka Prefecture (33°37'37.0"N, 130°25'30.4"E) for the hybrids. I planted each individual with a pot placed under natural light and temperature in an experimental farm of the Hakozaki campus.

I collected 176 slugs (*Lehmannia valentiana*) in the experimental farm at the Hakozaki campus of Kyushu University from July 13-14, 2012, and measured their body weight. All individuals weighing 0.2-0.7g were placed in two plastic containers (15.5 x 12 x 8.5 cm) lined with a sheet of moistened filter paper and kept at room temperature (24-32° C). They were supplied with fresh vegetable (cabbage, cucumber and garland chrysanthemum) free from insecticides, dry cat food (Sheba Duo) and frozen fresh pollen for beekeeping (Kumagaya-yoho) every day.

Measurement of the lengths of inner phyllaries and florets

Because I noticed difference of capitulum morphology between the hybrids and *T. japonicum*, I measured the length of inner phyllaries and florets for 47 individuals of *T. japonicum* and 47 hybrids. For each individual, I randomly collected three inner phyllaries and three florets of a capitulum, measured them and averaged the measurements. The length of a floret was defined as a length from the base of an ovary to the top of a pistil.

Experiment 1: Comparing slug damage between native and hybrid dandelions

I tested slug damage to native or hybrid dandelions at night when capitula were closed. The experiment was conducted from 25 June to 6 July 2012. Eight pairs of a native dandelion and a hybrid were placed in a 5 m x 5 m area under natural light in a greenhouse (not heated). Each pair was placed at a distance of 50 cm from each other (Fig. 1). To equalize flower display between individuals, I cut extra capitula so that each individual had only one capitulum.

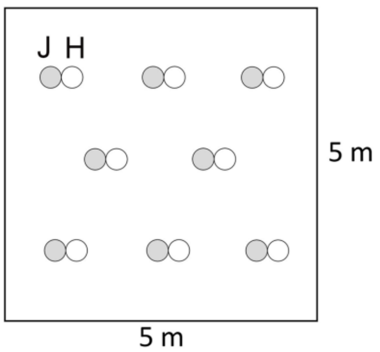

Fig.1 Placement of eight pairs of experimental plants. Grey circles represent native dandelion (J, *Taraxacum japonicum*), and white circles represent hybrids(H, *Taraxacum officinale x Taraxacum japonicum*). The distance between each pair is 50 cm

On the day of each experiment, I randomly selected 60 free-moving captive slugs and released them to the experimental area at 6:00 p.m. I checked any feeding damage of each capitulum at 9:00 am in the next morning. To avoid any effect by remained mucus of slugs, each dandelion was not reused.

Experiment 2: Comparing slug behavior on capitula of native and hybrid dandelions

From 29 June to 7 July 2013, I observed slug behavior on capitula of the hybrids and *T. japonicum* with and without recurved phyllaries, respectively. One experimental trial included two observations. First, I released one slug individual below Point C (Fig. 2) of a stem of *T. japonicum*, and recorded the slug's behavior on the flowering stem by a video camera (Sony HDR-CX590V), and then picked the slug up after the observation. Second, I released the same slug below Point C of a stem of a hybrid and recorded the slug's behavior on the stem. I made this series of observations for 30 slugs. To avoid any effect of locomotion mucus left by a slug used in the first observation, the stem of an experimental dandelion was cleaned with moist tissue paper before the second observation. Using the video records, I measured times a slug spent in Segment 1 and Segment 2 of a flowering stem that are equal in length (Fig. 2). Segment 1 consisted only of the upper part of a stem and Segment 2 consisted of a capitulum including phyllaries and a short length of a stem just below the capiculum.

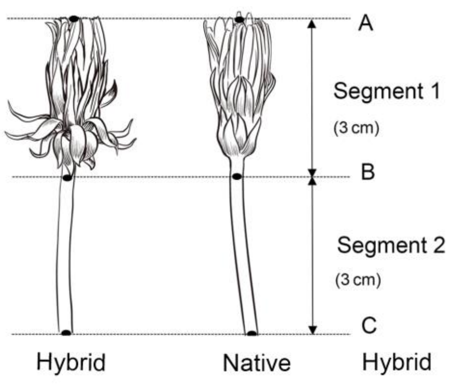

Fig. 2 Definition of Segment 1 and Segment 2 observed in the experiment 2. Left, hybrid dandelion; right, native dandelion.

Experiment 3: Observing slug behavior on a capitulum in which recurved phyllaries were removed

I experimentally removed recurved outer phyllaries of hybrids by 14 slugs from 2 to 6 July 2013. Then, I compared slug behavior on the capitulum without phyllaries with slug behavior on the capitulum of *T. japonicum* originally without phyllaries (Fig. 3). As a control, I also observed slug behavior on the capitulum of a hybrid with phyllaries (non-treated). First, I released a slug below Point C of a stem of *T. japonicum*, observed slug behavior with a video camera, and then picked the slug up after the observation. Second, I released the same slug on a stem of a hybrid in which recurved phyllaries were experimentally cut, observed its behavior with a video-camera, and picked it up. Third, I released the same slug on a stem of a hybrid in which recurved phyllaries are not treated and video-recorded its behavior. I used two hybrid individuals (with and without recurved phyllaries) and one individual of *T. japonicum* per daily experiment, in which all capitula were reused on the same day and cut off after a daily experiment.

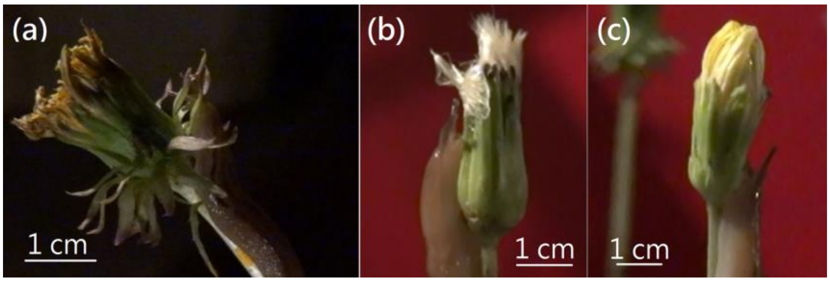

Fig. 3 Slug behavior on a capitulum. a A slug trying to cross over the recurved phyllaries of a hybrid dandelion. b A slug going up to a capitulum of a hybrid dandelion in which recurved phyllaries were experimentally removed. c A slug going up to a capitulum of *Taraxacum japonicum*.

Geographical distribution of species having recurved phyllaries in Eurasia

I surveyed the flora of Japan (Morita 1995), China (Ge et al. 2011), Taiwan (Peng et al. 1998), Iran (Safavi et al. 2013) , Ibéria (Galán de Mera 2016) and Europe (Richards and Sell 1976) and some new species reports of *Taraxacum* in Eurasia (Dudman and Richards 1994; Sonck 1999; Kirschner and Štěpánek 2005; Lundevall and Øllgaard 2006; Øllgaard 2006; Abedin 2007; Jafari and Assadi 2007; Trávníček et al. 2007; Uhlemann 2007; Aquaro et al. 2007,2008; Trávníček et al. 2008; Peruzzi et al. 2009; Galán de Mera and Vicente Orellana 2010; Trávníček and Vašut 2011; Galán de Mera et al. 2012)**.** I recorded their phyllary morphology as “recurved” or “erect”. If a species is described as “recurved or curved” or “curved to recurved”, it was recorded as “recurved”.

Results

Morphological difference of inner phyllaries

Hybrids differ from *T. japonicum* in having not only recurved outer phyllaries but also longer inner phyllaries (Fig. 4). Inner phyllaries of the hybrids (1.49±0.12 cm) were significantly longer than florets (1.37±0.11 cm; n=48; t-test p<0.01; Fig. 4a, c). In contrast, inner phyllaries of *T. japonicum* (1.26±0.10 cm) were significantly shorter than florets (1.48±0.12 cm; n=48; t-test p<0.01; Fig.4a, b).

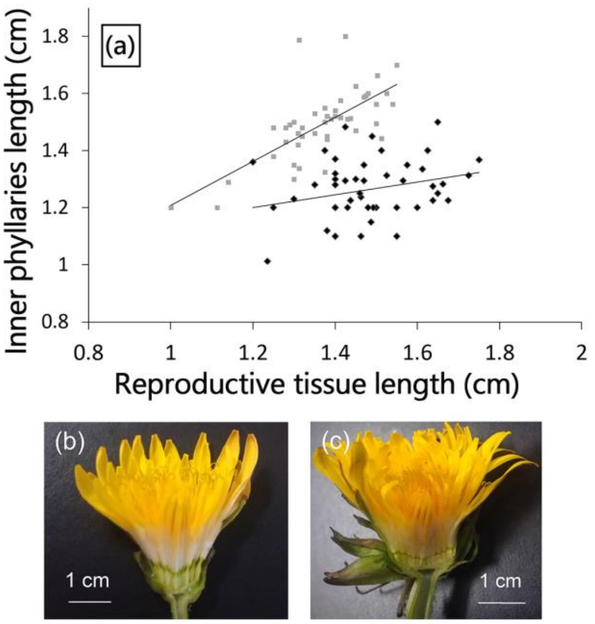

Fig. 4 a The difference in length between sepals and reproductive tissues of both dandelion., Black squares native dandelions; grey squares, hybrids. **b** and **c** Longitudinal sections of open capitula. **b** *Taraxacum japonicum,* **c** hybrid dandelion

Experiment 1: Comparing slug damage between native and hybrid dandelions

Whereas the upper part of capitula was completely closed by inner phyllaries in hybrid dandelions, the upper part of capitula was not completely closed at night by inner phyllaries and thus partly exposed to slugs in native dandelions (Figure 3c). As a result, in native dandelions, the lower part of capitula was not damaged, but the upper part including pistils, anthers and most of petals was eaten completely. All of eight native dandelions tested were damaged by slugs while none of eight hybrid dandelions was damaged on all five days of June 25, June 28, July 1, July 4 and July 6. All the damaged capitula could open again in the next morning, but most of petals were lost and thus display size was much reduced.

Experiment 2: Comparing slug behavior on capitula of native and hybrid dandelions

For 30 slugs observed on Segment 2 (see Fig. 2), a slug spent 32.0±31.08 sec on a stem of *T. japonicum*, and 40.3±17.96 sec on a stem of the hybrid, but the difference was not significant (t-test, p=0.174 Fig. 5a). Among those 30 slugs, nine individuals moved back when they touched recurved phyllaries of the hybrids. For the other 21 individuals, a slug spent 129.8±41.24 sec on Segment 1 of the hybrids, and 45.8±36.43 sec on Segment 1 of *T. japonicum* (t-test, p <0.005, Fig. 5a).

Experiment 3: Observing slug behavior on a capitulum in which recurved phyllaries were removed

In 14 slugs observed, the handling time on Segment 2 did not differ significantly among three treatment groups (ANOVA $F_{2,14}$= 3.07, p=0.056, Fig. 5b). Among 14 slugs, one individual moved back when it touched recurved phyllaries of a hybrid with phyllaries (non-treated control). For the other 13 slugs, the handling time on Segment 1 showed a significant difference among three treatment groups (ANOVA $F_{2,13}$= 12.82, p<0.05, Fig. 5b). A slug spent 84.64±44.68 sec on the hybrids with recurved phyllaries, 41.21±28.63 sec on the hybrids from which recurved phyllaries were removed, and 32.07±17.10 sec on *T. japonicum*. The difference between the hybrids from which recurved phyllaries were removed (p=0.35, Holm method) and *T. japonicum* in which phyllaries were not recurved was not significant (p=0.58, Holm method), while the difference between the hybrids with removed and non-removed recurved phyllaries was significant (p<0.001) and the difference between the hybrids with recurved phyllaries and *T. japonicum* was also significant (p<0.001).

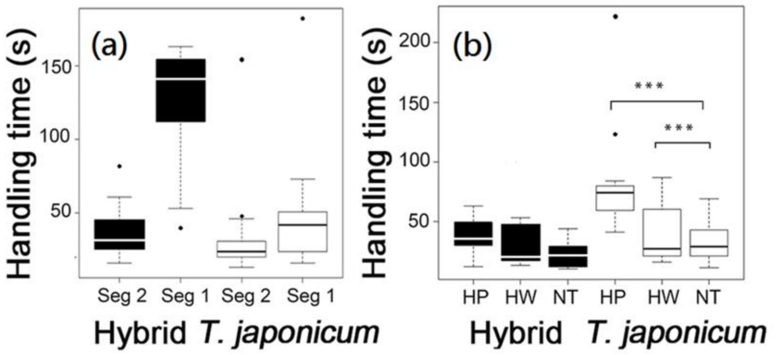

Fig. 5 Handling time of slugs on Segment 1 and Segment 2 of *Taraxacum japonicum* and the hybrids. **a** The results of experiments using non-treated plants. **b** The results from three treatments (HP: hybrids with phyllary, HW: hybrids without phyllary, NT: Native *T. japonicum*).

The geographical variation of phyllary morphology in Eurasia

Using local flora and taxonomic literature, I checked whether phyllaries are recurved or not for 572 *Taraxacum* species in Eurasia (Table 1, Fig. 6). Among 132 East Asian species, only 5 species have recurved phyllaries. Among 440 central Eurasian and European species, 267 species have recurved phyllaries. In Iberian Peninsula where *Lehmannia valentiana* is native, 61% (30 among 49 species) of *Taraxacum* species have recurved phyllaries.

Fig.6 The geographical variation of phyllary morphology in Eurasia.

Discussion

Recurved phyllaries as a defense against slugs

My experiment showed that a slug *Lehmannia valentiana* naturalized in Japan gave serious damage to flowers of *T. japonicum*, but did not give any damage to the hybrid with recurved phyllaries. In *T. japonicum*, the upper part of capitula including pistils, anthers and most of petals was eaten completely. Because *T. japonicum* is sexual and self-incompatible, this damage results in loss of both female and male fitness. When *L. valentiana* were experimentally placed on the stem of the hybrid, they moved back when they touched the recurved phyllaries or spent more than two times longer on them to go across than on the non-recurved phyllaries of *T. japonicum*. Those findings support a hypothesis that recurved phyllaries of European dandelions and the hybrids function as a physical defense against florivory by *L. valentiana*. In addition, *L. valentiana* went up to the top of a capitulum could not feed florets of the hybrid because the florets were completely enclosed by the inner phyllaries that were closed at night. On the other hand, the florets of *T. japonicum* were partly exposed out of the inner phyllaries at night and thus slugs could feed on them.

As far as I know, this is the first study demonstrating that floral morphology can function as a defense mechanism against florivory. While flowering plants developed various direct defense mechanisms against florivory including chemical (Adler et al. 2001) and physical (McCall and Irvin

2006) barriers, evidence of physical barriers to florivory is limited in spite that those are common mechanisms against leaf and shoot herbivores (Textor and Gershenzon 2009; Schaffner et al. 2011; Yamawo and Hada 2010). Although McCall and Irvin (2006) suggested that morphological traits such as trichomes and nyctinasty may provide a physical barrier that can help protecting reproductive tissue, there was no empirical evidence supporting this suggestion except the study on *Monotropisis odorata* in which experimental removal of dried bracts resulted in significantly higher florivory rate and significantly lower fruit production than controls (Klooster et al. 2009). From this finding, Klooster et al. (2009) concluded that dried bracts with cryptic coloration effectively camouflage conspicuous floral tissues and reduce the frequency of florivory. My finding for dandelions is different from the case of *Monotropsis* in that not coloration but morphology supports a defense function.

My finding suggests that recurved phyllaries in other plant genera can also function as a defense mechanism against florivory. Asteraceae is unique in having phyllaries or involucral bracts that are interpreted as modified leaves or modified bud scales (Bremer 1994). In most species, phyllaries are erect and tightly packing flowers (florets) but become loose and often spread in a fruiting stage. On the other hand, recurved phyllaries evolved in many lineages of Asteraceae: among representative species for which photographes are shown in Funk et al. (2009), *Arnaldoa weberbaueri* of Barnadesieae (Barnadesioideae), *Dicoma capensis* of Dicomeae (Caruduoideae), *Cirsium arvense* of Cardueae (Carduoideae), *Picris scabra* of Cichorieae, *Berkheya cirsiifolia* of Arctotideae, *Paranephelius uniflorus* of Liabeae, and *Stenachaenium megapotanicum* of Inuleae have recurved phyllaries, while many other species of the same tribes have erect phyllaries. My finding suggests that those changes from erect to recurved phyllaries are likely to be defensive adaptations to florivorous animals like slugs.

No previous studies have been made on physical defense against florivory by slugs in spite that slugs are well known florivores. In Europe, where *T. officinale* is native, there are some observations on florivory by slugs. Breadmore and Kirk (1998) observed the amount of herbivore damage (damage mostly by slugs) to the petals of 41 herbaceous species in a limestone grassland of central England where a slug *Deroceras reticulatum* is the main petal herbivore. The mean damage across species was 2 %, ranging from 0 % in *Galium sterneri* to 8 % in *Primula vulgaris*, and the mean floral damage of *Taraxacum* spp. was as low as 0.21%. More recently, Honěk and Martinkova (2014) observed florivory of an invasive slug *Arion lusitanicus* for flower heads of *T. officinale* native in Czech Republic. They observed 547 flower heads of *T. officinale* among which approximately 40% was damaged by slugs. They suggested that the high percentage of floral herbivory in their study was possibly due to very high density (49.0 ± 8.16 slugs/m^2) of *A. lusitanicus* in their observation site. Notably, grazing of slugs on flowers was observed before sunset; during about 1 h between 18:30 when the slugs climbed up onto the heads and 19:30 when the heads closed at sunset. On the other hand, *Lehmannia valentiana* I observed in this study grazed flower heads of *T. japonicum* only after sunset in Japan. The higher percentage of slug damage observed in Czech may be due to the foraging activity of *A. lusitanicus* before sunset when flower heads are not yet completely closed. Considering frequent foraging activity of slugs in Europe, it is likely that any defense mechanism against florivory by slugs is advantageous for European dandelions. In Japan, however, there have been no reports on florivory by native slugs on not only *Taraxacum* but also other native plants. This lack may be due to deficiency of field observations on florivory in Japan or evolutionary history between flowering plants in Japan and native slugs.

My finding is an example of antagonistic interactions between alien plants and alien herbivores. Recently, there has been an increasing awareness that alien plants may facilitate alien herbivores (see Meza-Lopez and Siemann 2015). In a case studied by Meza-Lopez and Siemann (2015), an alien snail (*Pomacea maculate*) preferentially consumed native plants and facilitated invasion of an alien plant *Alternanthera philoxeroides*. This relationship is very similar to the relationship I observed for the dandelion-slug interaction in that an alien slug preferentially consumed flowers of native dandelions. Therefore, this interaction may benefit alien and hybrid dandelions. In western Japan, native *T. japonicum* are often replaced with the hybrids in the field and Takakura et al. (2009) and Nishida et al. (2012) suggested that this replacement resulted from reproductive interference. The dandelion-slug interaction could be another factor promoting this replacement and and testing this possibility would deepen my understanding on the declining process of *T. japonicum*.

Evolutionary history of *Taraxacum* species with erect and recurved phyllaries

My survey showed that most *Taraxacum* species (127 among 132 species) in East Asia have erect phyllaries but many *Taraxacum* species in Europe and central Asia (267 among 440 species) have recurved phyllaries (Table 1). These regional differences in phyllary morphology may be related to the migration history of *Taraxacum* in Eurasia. Richards (1973) surmised that the genus *Taraxacum* was originated in the Himalaya region and then expanded westward to Asia Minor and the Mediterranean, and the advanced sections have spread to the East Asia finally. However, his argument was not based on any phylogenetic evidence. Recently, Kirschner et al. (2003) examined sequence variation and RFLPs of cpDNA, but they could not get any reliable resolution for the phylogeny of *Taraxacum*. Thus, Kirschner et al. (2003) employed a cladistic analysis based on 15 morphological characters and suggested that Sect. *Suavia* is ancestral to all the other sections of *Taraxacum*. They regarded appressed to ± erect outer phyllaries as an ancestral state and recurved or arcuate outer phyllaries as a derived state because an outgroup *Crepis* has appressed to erect outer phyllaries. According to Kirschner and Štěpánek (2005), all the species of Sect. *Suavia*, distributed in northern Mongolia and its adjacent region, have appressed outer phyllaries. More recent molecular studies using nrDNA gave a limited congruence with cpDNA phylogeny (Kirschner et al. 2003) and the established taxonomic system of the genus *Taraxacum*, probably because of frequent hybridization in the evolutionary history of *Taraxacum* (Kirschner et al. 2015). Considering the available evidence summarized above, the recurved phyllary of many European species including *T. officinale* is considered to be a derived trait evolved as an adaptation to any environment in Europe.

It is notable that Japanese dandelions have inner phyllaries shorter than florets and consequently reproductive tissues, including pollen with a high-nitrogen content (Primack 1985; Roulston et al. 2000) are damaged by slugs at night. I suggest that nyctinasty of Japanese dandelions may be effective against native florivores, but less effective against introduced slugs. In Europe, threats of florivory by slugs may be higher because they are active before sunset (Honěk & Martinková 2014) and the recurved outer phyllaries and longer inner phyllaries may have evolved under this florivory pressure. Further studies on interactions of slugs and dandelions in both Europe and Asia are waited to deepen my understanding on the function and evolutionary history of recurved phyllaries in *Taraxacum*.

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Table. 1 The geographical variation of phyllary morphology of *Taraxacum* in Eurasia.

Species	**Section**	**Erect**	**Recurve**	**Reference**
Taraxacum abax	*Stenoloba*	+		Ge et al. (2011)
Taraxacum abbreviatulum	*Qaisera*	+		Ge et al. (2011)
Taraxacum aberrans	*Ruderalia*		+	Trávníček et al. (2007)
Taraxacum acutangulum	*Ruderalia*			Galán de Mera (2015);Richards and Sell (1976)
Taraxacum acutifrons	*Ruderalia*		+	Trávníček et al. (2007)
Taraxacum adamii	*Spectabilia*	+		Richards and Sell (1976)
Taraxacum adglabrum	*Qaisera*	+		Ge et al. (2011)
Taraxacum aellenii	*Erythrocarpa*		+	Safavi et al. (2013)
Taraxacum aeneum	*Qaisera*			Ge et al. (2011)
Taraxacum aequilobum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum aesivum	*Alpestria*	+		Richards and Sell (1976)
Taraxacum afghanicum	*Macrocornuta*		+	Safavi et al. (2013)
Taraxacum alatavicum	*Macrocornuta*		+	Safavi et al. (2013)
Taraxacum alatopetiolum	*Arctica*	+		Ge et al. (2011)
Taraxacum alatum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum albidum	*Mongolica*	+		Morita (1995)
Taraxacum albiflos	*Leucantha*	+		Ge et al. (2011)
Taraxacum albomarginatum	*Mongolica*	+		Ge et al. (2011)
Taraxacum album	*Leucantha*	+		Ge et al. (2011)
Taraxacum alii	*Parvula*		+	Abedin (2007)
Taraxacum alpicola	*Borealia*	+		Morita (1995)
Taraxacum amborum	*Erythrocarpa*	+		Richards and Sell (1976)
Taraxacum ancistratum	*Ruderalia*		+	Trávníček et al. (2007)
Taraxacum ancistrolobum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum andorriense	*Arctica*	+		Galán de Mera (2015)
Taraxacum anglicum	*Palustria*	+		Richards and Sell (1976)
Taraxacum angustisquameum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum apenninum	*Alpina*	+		Richards and Sell (1976)
Taraxacum apargia	*Tibetana*	+		Ge et al. (2011)
Taraxacum apargiiforme	*Tibetana*	+		Ge et al. (2011)
Taraxacum aquilonare	*Erythrocarpa*	+		Richards and Sell (1976)
Taraxacum aragonicum	*Alpina*	+		Galán de Mera (2015)
Taraxacum arctitum	*Arctica*	+		Richards and Sell (1976)

Taraxacum armeriifolium	*Leucantha*	+		Ge et al. (2011)
Taraxacum arrhenii	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum asturiense	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum atrocarpum	*Tibetana*	+		Ge et al. (2011)
Taraxacum atrovirens	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum atroviride	*Ruderalia*		+	Trávníček et al. 2008
Taraxacum aurantiacum Dahlst	*Ruderalia*	+		Safavi et al. (2013); Jafari & Assadi (2007)
Taraxacum aurantiacum Dahlstedt	*Mongolica*	+		Ge et al. (2011)
Taraxacum aureocucullatum	*Cucullata*	+		Richards and Sell (1976)
Taraxacum aurosulum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum austrotibetanum	*Tibetana*	+		Ge et al. (2011)
Taraxacum austriacum	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum austrinum	*Palustria*	+		Richards and Sell (1976)
Taraxacum ayllonense	*Alpina*	+		Galán de Mera (2015)
Taraxacum azerbaijanicum	*Erythrosperma*		+	Safavi et al. (2013)
Taraxacum badiocinnamomeum	*Emodensia*	+		Ge et al. (2011)
Taraxacum badium	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum balearicum	*Erythrosperma*		+	Galán de Mera (2015)
Taraxacum balticiforme	*Palustria*	+		Richards and Sell (1976)
Taraxacum balticum	*Palustria*	+		Richards and Sell (1976)
Taraxacum baltistanicum	*Orientalia*	+		Safavi et al. (2013)
Taraxacum bellum	*Ruderalia*		+	Trávníček et al. (2007)
Taraxacum bessarabicum (Hornem.)	*Ruderalia*	+		Galán de Mera (2015);Richards and Sell (1976); Safavi et al. (2013)
Taraxacum bessarabicum (Hornemann)	*Piesis*	+		Ge et al. (2011)
Taraxacum bicorne	*Ceratoidea*	+		Ge et al. (2011)
Taraxacum biformatum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum bithynicum	*Scariosa*	+		Richards and Sell (1976)
Taraxacum boekmanii	*Hamata*		+	Trávníček and Vašut (2011)
Taraxacum borgvallii	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum brachyceras	*Ceratophora*	+		Richards and Sell (1976)
Taraxacum brachyglossum	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum bracteatum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum braunblanquetii	*Erythrosperma*		+	Richards and Sell (1976)

Taraxacum breconense	*Celtica*		+	Dudman and Richards(1994)
Taraxacum brevicorniculatum	*Qaisera (Ceratoidea)*			Ge et al. (2011)
Taraxacum brevirostre	*Oligantha*	+		Safavi et al. (2013)
Taraxacum broddesonii	*Ruderalia*		+	Lundevall and Øllgaard, 2006
Taraxacum calabricum	*Ruderalia*		+	Aquaro et al. (2008)
Taraxacum calanthodium	*Calanthodia*	+		Ge et al. (2011)
Taraxacum caloschistum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum candidatum	*Leucantha*	+		Ge et al. (2011)
Taraxacum canoviride	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum cantabricum	*Arctica*	+		Galán de Mera (2015)
Taraxacum canulum	*Erythrosperma*	+		Richards and Sell (1976)
Taraxacum capricum	*Erythrocarpa*	+		Richards and Sell (1976)
Taraxacum caramanicae	*Erythrocarpa*	+		Richards and Sell (1976)
Taraxacum carinthiacum	*Alpina*	+		Richards and Sell (1976)
Taraxacum carthusianorum	*Palustria*		+	Aquaro et al. (2008)
Taraxacum caudatulum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum celsum	*Turrita*		+	Ge et al. (2011)
Taraxacum centrasiaticum	*Tibetana*	+		Ge et al. (2011)
Taraxacum ceratolepis	*Mongolica*	+		Morita (1995)
Taraxacum ceratolobum	*Spectabilia*	+		Richards and Sell (1976)
Taraxacum ceratophorum	*Ceratophora*	+		Richards and Sell (1976)
Taraxacum cereum	*Leucantha*	+		Ge et al. (2011)
Taraxacum cescae	*Ruderalia*		+	Aquaro et al. (2008)
Taraxacum chionophilum	*Tibetana*	+		Ge et al. (2011)
Taraxacum chitralense	*Sinensia*		+	Safavi et al. (2013)
Taraxacum christiansenii	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum chrysophaenum	*Ruderalia*		+	Trávníček et al. (2007)
Taraxacum ciliare	*Palustria*	+		Galán de Mera (2015)
Taraxacum clarum	*Ruderalia*		+	Trávníček et al. 2008
Taraxacum cochleatum	*Boreigena*		+	Richards and Sell (1976)
Taraxacum columnare	*Ruderalia*		+	Galán de Mera (2015)
Taraxacum commixtum	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum concucullatum	*Cucullata*	+		Richards and Sell (1976)
Taraxacum consanguineum	*Parvula*	+		Ge et al. (2011)
Taraxacum copidophyllum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum cordatifolium	*Alpestria*	+		Richards and Sell (1976)

Taraxacum cordatum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum coreanum	*Mongolica*	+		Galán de Mera (2015), Ge et al. (2011)
Taraxacum craspedotum	*Spectabilia*	+		Richards and Sell (1976)
Taraxacum crassipes	*Boreigena*		+	Richards and Sell (1976)
Taraxacum crepidiforme DC.	*Orientalia*	+		Safavi et al. (2013)
Taraxacum crepidiforme subsp.Kurdicum	*Orientalia*	+		Safavi et al. (2013)
Taraxacum crispifolium	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum croceiflorum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum crocelarpum	*Fontana*		+	Richards and Sell (1976)
Taraxacum croceum	*Spectabilia*	+		Richards and Sell (1976)
Taraxacum crocodes	*Palustria*	+		Richards and Sell (1976)
Taraxacum cucullatiforme	*Cucullata*	+		Richards and Sell (1976)
Taraxacum cucullatum	*Cucullata*	+		Richards and Sell (1976)
Taraxacum cyanolepis	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum cyathiforme	*Qaisera*	+		Ge et al. (2011)
Taraxacum cymbifolium	*Spectabilia*	+		Richards and Sell (1976)
Taraxacum dahlstedtii	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum damnabile	*Qaisera*	+		Ge et al. (2011)
Taraxacum darbandense	*Erythrocarpa*		+	Safavi et al. (2013)
Taraxacum dasypodum	*Parvula*	+		Ge et al. (2011)
Taraxacum dealbatum	*Leucantha*	+		Ge et al. (2011)
Taraxacum decastroi	*Fontana*	+		Galán de Mera (2015); Galán de Meraand Vicente Orellana (2010)
Taraxacum decipiens	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum degelii	*Erythrosperma*	+		Richards and Sell (1976)
Taraxacum deltoidifrans	*Ruderalia*		+	Trávníček et al. (2007)
Taraxacum delicatum	*Tibetana*			Ge et al. (2011)
Taraxacum deludens	*Emodensia*	+		Ge et al. (2011)
Taraxacum dentilobum	*Ruderalia*	+		Galán de Mera (2015)
Taraxacum denudatum	*Mongolica*	+		Morita (1995)
Taraxacum dilaceratum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum dilatatum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum dissectum	*Dissecta*	+		Richards and Sell (1976)
Taraxacum disseminatum	*Erythrosperma*		+	Richards and Sell (1976)

Taraxacum dissimile	*Erythrosperma*	+		Richards and Sell (1976)
Taraxacum divulsifolium	*Palustria*	+		Richards and Sell (1976)
Taraxacum dorchocarpum	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum dovrense	*Arctica*	+		Richards and Sell (1976)
Taraxacum drueci	*Celtica*		+	Galán de Mera (2015)
Taraxacum dunense	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum duplidens	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum duriense	*Celtica*		+	Galán de Mera (2015)
Taraxacum duriense	*Erythrocarpa*	+		Richards and Sell (1976)
Taraxacum edessicoides	*Erythrosperma*		+	Uhlemann 2007
Taraxacum edmondsonianum	*Ruderalia*		+	Dudman and Richards (1994)
Taraxacum ekmanii	*Ruderalia*		+	Galán de Mera (2015);Richards and Sell (1976)
Taraxacum elegantius	*Ruderalia*		+	Galán de Mera (2015)
Taraxacum epirense	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum eriopodum	*Tibetana*	+		Ge et al. (2011)
Taraxacum erythrospermum	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum erythropodium	*Mongolica*	+		Ge et al. (2011)
Taraxacum estrelense	*Celtica*		+	Galán de Mera (2015)
Taraxacum euryphyllum	*Spectabilia*	+		Richards and Sell (1976)
Taraxacum eximium	*Spectabilia*	+		Richards and Sell (1976)
Taraxacum expallidiforme	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum expandens	*Borea*		+	Lundevall & Øllgaard, 2006
Taraxacum explicatum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum faeroense	*Spectabilia*	+		Richards and Sell (1976)
Taraxacum falcatum	*Erythrosperma*	+		Richards and Sell (1976)
Taraxacum fasciatum	*Ruderalia*		+	Trávníček et al. (2007),
Taraxacum fasciatum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum finitimum	*Borea*		+	Lundevall and Øllgaard (2006)
Taraxacum florstroemii	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum florum	*Qaisera*	+		Ge et al. (2011)
Taraxacum fontanicola	*Fontana*		+	Richards and Sell (1976)
Taraxacum fontaniforme	*Cucullata*	+		Richards and Sell (1976)
Taraxacum fontanosquameum	*Fontana*		+	Richards and Sell (1976)
Taraxacum fontanum	*Fontana*	+		Galán de Mera (2015); Richards and Sell (1976)
Taraxacum formosanum	*Mongolica*	+		Peng et al. (1998)

Taraxacum forrestii	*Calanthodia*	+		Ge et al. (2011)
Taraxacum freticola	*Ruderalia*		+	Øllgaard,2006
Taraxacum frisicum	*Palustria*	+		Richards and Sell (1976)
Taraxacum fulvicarpum	*Spectabilia*	+		Richards and Sell (1976)
Taraxacum fulviforme	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum fulvum	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum fusciflorum	*Hamata*		+	Trávníček and Vašut (2011)
Taraxacum galeatum	*Boreigena*		+	Richards and Sell (1976)
Taraxacum garbarianum	*Erythrocarpa*	+		Peruzzi et al.(2009)
Taraxacum gasparrinii	*Erythrosperma*		+	Galán de Mera (2015);Richards and Sell (1976)
Taraxacum geminatum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum germanicum	*Palustria*	+		Richards and Sell (1976)
Taraxacum gibberum	*Ruderalia*		+	Trávníček et al. (2007);Richards and Sell (1976)
Taraxacum gilgitense	*Macrocornuta*	+		Abedin 2007
Taraxacum glabrum Candolle	*Glabra*	+		Ge et al. (2011)
Taraxacum glabrum DC	*Arctica*	+		Richards and Sell (1976)
Taraxacum glaciale	*Glacialia*	+		Richards and Sell (1976)
Taraxacum glandiforme	*Alpestria*		+	Galán de Mera (2015)
Taraxacum glaucanthum	*Macrocornuta*	+		Richards and Sell (1976)
Taraxacum glauciniforme	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum glaucinum	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum glaucophylloides	*Emodensia*	+		Ge et al. (2011)
Taraxacum glaucophyllum	*Emodensia*	+		Ge et al. (2011)
Taraxacum goloskokovii	*Atrata*	+		Ge et al. (2011)
Taraxacum gotlandicum	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum gracillimum	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum grypodon	*Calanthodia*	+		Ge et al. (2011)
Taraxacum haematicum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum haematopus	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum hamatiforme Dahlst.	*Hamata*		+	Trávníček and Vašut (2011);Richards and Sell (1976)
Taraxacum hamatum	*Hamata*		+	Trávníček and Vašut (2011);Richards and Sell (1976)
Taraxacum handelii	*Arctica*	+		Richards and Sell (1976)
Taraxacum hastatum	*Taraxacum*		+	Richards and Sell (1976)

Taraxacum haworthianum	*Erythrosperma*	+		Dudman and Richards (1994)
Taraxacum heleonastes	*Palustria*	+		Richards and Sell (1976)
Taraxacum helveticum	*Alpina*	+		Richards and Sell (1976)
Taraxacum hepaticolor	*Erythrosperma*		+	Safavi et al. (2013)
Taraxacum hideoi	*Mongolica*	+		Morita (1995)
Taraxacum hirsutissimum	*Naevosa*		+	Dudman and Richards (1994)
Taraxacum hispanicum	*Erythrocarpa*		+	Galán de Mera (2015)
Taraxacum hollandicum	*Palustria*	+		Richards and Sell (1976)
Taraxacum homoschitum	*Ruderalia*		+	Øllgaard (2006)
Taraxacum hoppeanum	*Erythrocarpa*	+		Richards and Sell (1976)
Taraxacum horizontale	*Qaisera*	+		Ge et al. (2011)
Taraxacum horridifrons	*Ruderalia*		+	Trávníček et al. (2007)
Taraxacum huddungense	*Ruderalia*		+	Lundevall and Øllgaard (2006)
Taraxacum huelphersianum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum hybernum	*Macrocornuta*	+		Richards and Sell (1976)
Taraxacum hydrophilom	*Orientalia*		+	Safavi et al. (2013)
Taraxacum iberanthum	*Celtica*		+	Galán de Mera (2015)
Taraxacum icterinum	*Qaisera*	+		Ge et al. (2011)
Taraxacum ikonnikovii	*Leucantha*	+		Ge et al. (2011)
Taraxacum iliense	*Leucantha*	+		Ge et al. (2011)
Taraxacum illyricum	*Palustria*	+		Richards and Sell (1976)
Taraxacum imbricatius	*Qaisera*	+		Ge et al. (2011)
Taraxacum inclusum	*Cucullata*	+		Richards and Sell (1976)
Taraxacum infradentatum	*Alpestria*		+	Galán de Mera (2015)
Taraxacum insigne	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum involucratum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum iranicum	*Oligantha*		+	Safavi et al. (2013)
Taraxacum isophyllum	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum isthmicola	*Erythrosperma*	+		Richards and Sell (1976)
Taraxacum janalamii	*Oligantha*	+		Abedin 2007
Taraxacum japonicum	*Mongolica*	+		Morita (1995)
Taraxacum junpeianum	*Mongolica*	+		Ge et al. (2011)
Taraxacum kalambakae	*Ruderalia*		+	Snock(1999)
Taraxacum kalchailum	*Erythrosperma*		+	Safavi et al. (2013)
Taraxacum kirschneri	*Ruderalia*		+	Aquaro et al. (2008)
Taraxacum kiushianum	*Mongolica*	+		Morita (1995)
Taraxacum kjellmanii	*Taraxacum*		+	Richards and Sell (1976)

Taraxacum klokovii	*Macrocornuta*	+		Richards and Sell (1976)
Taraxacum koelzii	*Spuria*		+	Safavi et al. (2013)
Taraxacum kok-saghyz Rodin	*Macrocornuta*	+		Richards and Sell (1976);Ge et al. (2011)
Taraxacum Kotschyi	*Rhodotricha*	+		Safavi et al. (2013)
Taraxacum kozlovii	*Emodensia*	+		Ge et al. (2011)
Taraxacum kurdiciforme	*Vulgaria*		+	Safavi et al. (2013)
Taraxacum kuusamoense	*Boreigena*		+	Richards and Sell (1976)
Taraxacum lacianense	*Fontana*		+	Galán de Mera (2015); Galán de Mera and Vicente Orellana(2010)
Taraxacum laciniosifrons	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum laciniosum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum lacistophyllum	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum laeticolor	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum laetiforme	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum laetum	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum laholense	*Macrocornuta*	+		Abedin (2007)
Taraxacum lainzii	*Spectabilia*	+		Richards and Sell (1976)
Taraxacum lambinoii	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum lamprolepis	*Mongolica*	+		Ge et al. (2011)
Taraxacum lamprophyllum	*Hamata*		+	Trávníček and Vašut (2011)
Taraxacum landmarkii	*Spectabilia*	+		Richards and Sell (1976)
Taraxacum lanigerum	*Calanthodia*	+		Ge et al. (2011)
Taraxacum latens	*Ruderalia*		+	Dudman and Richards (1994)
Taraxacum leptodon	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum leptoscelum	*Ruderalia*		+	Øllgaard,2006; Galán de Mera (2015)
Taraxacum leucospermum	*Obovata*	+		Richards and Sell (1976)
Taraxacum liaotungense	*Mongolica*	+		Ge et al. (2011)
Taraxacum lilacinum	*Atrata*	+		Ge et al. (2011)
Taraxacum lilianae	*Palustria*	+		Aquaro et al. (2008)
Taraxacum limbatum	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum limnanthes	*Palustria*	+		Richards and Sell (1976)
Taraxacum linguatum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum lingulatum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum litardieri	*Arctica*	+		Richards and Sell (1976)
Taraxacum litophyllum	*Fontana*	+		Galán de Mera (2015)
Taraxacum litorale	*Spectabilia*	+		Richards and Sell (1976)

Taraxacum lividum	*Palustria*	+		Richards and Sell (1976)
Taraxacum longisquameum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum lucidum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum ludlowii	*Emodensia*	+		Ge et al. (2011)
Taraxacum lugubre	*Calanthodia*	+		Ge et al. (2011)
Taraxacum lunare	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum luridum	*Leucantha*	+		Ge et al. (2011)
Taraxacum luteocucullatum	*Cucullata*	+		Richards and Sell (1976)
Taraxacum macranthum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum macrolepium	*Vulgaria*		+	Safavi et al. (2013)
Taraxacum macula	*Emodensia*	+		Ge et al. (2011)
Taraxacum maculatum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum maculigerum	*Spectabilia*	+		Richards and Sell (1976)
Taraxacum magnopyramidophorum	*Fontana*		+	Richards and Sell (1976)
Taraxacum malato-belizii	*Erythrosperma*		+	Galán de Mera (2015)
Taraxacum mansehracum	*Oligantha*	+		Abedin (2007)
Taraxacum marginatum	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum marginellum	*Erythrosperma*		+	Galán de Mera (2015)
Taraxacum marklundii	*Hamata*		+	Galán de Mera (2015)
Taraxacum marklundii	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum mastigophyllum	*Tibetana*	+		Ge et al. (2011)
Taraxacum mattmarkense	*Alpina*	+		Richards and Sell (1976)
Taraxacum maurocarpum	*Emodensia*	+		Ge et al. (2011)
Taraxacum megalorhizon	*Ruderalia*	+		Galán de Mera (2015)
Taraxacum megalorhizon	*Scariosa*	+		Richards and Sell (1976)
Taraxacum melanthoides	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum microcephaloides	*Rhodotricha*		+	Safavi et al. (2013)
Taraxacum microlobum	*Erythrosperma*	+		Richards and Sell (1976)
Taraxacum mimuloides	*Hamata*		+	Galán de Mera (2015)
Taraxacum mimulum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum minimun	*Scariosa*	+		Richards and Sell (1976)
Taraxacum minutilobum	*Oligantha*	+		Ge et al. (2011)
Taraxacum mitalii	*Parvula*	+		Ge et al. (2011)
Taraxacum moldavicum	*Ruderalia*		+	Trávníček et al.(2008)
Taraxacum mongolicum	*Mongolica*	+		Ge et al. (2011); Peng et al.(1998) ; Morita (1995)
Taraxacum montanum	*Spuria*		+	Safavi et al. (2013)

Taraxacum montesignum	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum mucronatum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum multilobum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum multiscaposum	*Macrocornuta*	+		Ge et al. (2011)
Taraxacum multisectum	*Stenoloba*	+		Ge et al. (2011)
Taraxacum multisinuatum	*Palustria*	+		Aquaro et al. (2008)
Taraxacum mutatum	*Tibetana*	+		Ge et al. (2011)
Taraxacum naevosiforme	*Spectabilia*	+		Richards and Sell (1976)
Taraxacum naevosum	*Spectabilia*	+		Richards and Sell (1976)
Taraxacum nanum	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum navacerradense	*Hamata*		+	Galán de Mera (2015)
Taraxacum neoaellenii	*Palustria*	+		Richards and Sell (1976)
Taraxacum neo-spurium	*Spuria*		+	Safavi et al. (2013)
Taraxacum neulobulatum	*Macrocornuta*	+		Safavi et al. (2013)
Taraxacum nevadense	*Pachera*	+		Galán de Mera (2015)
Taraxacum nevadense	*Arctica*	+		Richards and Sell (1976)
Taraxacum nevskii	*Macrocornuta*		+	Safavi et al. (2013)
Taraxacum nietoi	*Celtica*	+		Galán de Mera (2015)
Taraxacum nigrescens	*Ruderalia*	+		Øllgaard,2006
Taraxacum nigricans	*Alpestria*	+		Richards and Sell (1976)
Taraxacum nigridentatum	*Ruderalia*		+	Dudman and Richards (1994)
Taraxacum nikitinii Schischk.	*Macrocornuta*		+	Safavi et al. (2013)
Taraxacum nivale	*Arctica*	+		Richards and Sell (1976)
Taraxacum niveum	*Leucantha*	+		Ge et al. (2011)
Taraxacum nordstedtii	*Celtica*		+	Galán de Mera (2015)
Taraxacum nordstedtii	*Spectabilia*	+		Richards and Sell (1976)
Taraxacum nutans	*Biennia*	+		Ge et al. (2011)
Taraxacum obliquilobum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum obliquum	*Obliqua*	+		Richards and Sell (1976)
Taraxacum oblongatum	*Taraxacum*		+	Ge et al. (2011)
Taraxacum oblongatum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum obnuptum	*Borea*		+	Lundevall and Øllgaard (2006)
Taraxacum obovatum	*Hamata*		+	Galán de Mera (2015)
Taraxacum obovatum	*Obovata*	+		Richards and Sell (1976)
Taraxacum obscurans	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum occidentale	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum officinale	*Taraxacum*		+	Richards and Sell (1976)

Taraxacum ohirense	*Borealia*	+		Morita (1995)
Taraxacum ohwianum	*Calanthodia*	+		Ge et al. (2011)
Taraxacum opertum	*Ruderalia*		+	Øllgaard,2006
Taraxacum optimae	*Ruderalia*	+		Aquaro et al. (2008)
Taraxacum oreophilum	*Cucullata*	+		Richards and Sell (1976)
Taraxacum orientale	*Turrita*		+	Ge et al. (2011)
Taraxacum oxoniense	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum pacheri	*Arctica*	+		Richards and Sell (1976)
Taraxacum pachylobum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum pallescens	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum pallidippaposum	*Orientalia*	+		Safavi et al. (2013)
Taraxacum pallidulum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum palmgrenii	*Ruderalia*		+	Øllgaard,2006
Taraxacum palustre	*Palustria*	+		Richards and Sell (1976)
Taraxacum panalpinum	*Alpina*		+	Galán de Mera (2015);Richards and Sell (1976)
Taraxacum pannucium	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum pannulatiforme	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum pannulatum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum parsennense	*Alpina*	+		Richards and Sell (1976)
Taraxacum parvuliceps	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum parvulum	*Parvula*	+		Ge et al. (2011)
Taraxacum patiens	*Leucantha*	+		Ge et al. (2011)
Taraxacum peccator	*Calanthodia*	+		Ge et al. (2011)
Taraxacum pectinatiforme	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum pectinatum	*Mongolica*	+		Morita (1995)
Taraxacum penyalarense	*Naevosa*		+	Galán de Mera et al. (2012)
Taraxacum peregrinum	*Vulgaria*		+	Safavi et al. (2013)
Taraxacum perfissum	*Alpestria*	+		Richards and Sell (1976)
Taraxacum perplexans	*Qaisera*	+		Ge et al. (2011)
Taraxacum persicum	*Erythrosperma*		+	Safavi et al. (2013)
Taraxacum petiolulatum	*Alpina*	+		Richards and Sell (1976)
Taraxacum phymatocarpum	*Arctica*	+		Richards and Sell (1976)
Taraxacum piceatum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum pieninicum	*Erythrocarpa*	+		Richards and Sell (1976)
Taraxacum pilosella	*Ruderalia*		+	Lundevall and Øllgaard (2006)

Taraxacum pindicola	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum pingue	*Borealia*	+		Ge et al. (2011)
Taraxacum pinto-silvae	*Celtica*		+	Galán de Mera (2015)
Taraxacum placidum	*Erythrosperma*	+		Richards and Sell (1976)
Taraxacum platycarpum	*Mongolica*	+		Morita (1995)
Taraxacum platyglossum	*Obliqua*	+		Richards and Sell (1976)
Taraxacum platypecidum	*Calanthodia*	+		Ge et al. (2011)
Taraxacum platypecidum var. platypecidum	*Calanthodia*	+		Ge et al. (2011); Morita (1995)
Taraxacum plumbeum	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum pohii	*Fontana*		+	Richards and Sell (1976)
Taraxacum poliochlorum	*Erythrocarpa*	+		Richards and Sell (1976)
Taraxacum pollinense	*Ruderalia*	+		Aquaro et al. (2008)
Taraxacum polychroum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum polyodon	*Ruderalia*	+		Galán de Mera (2015)
Taraxacum polyodon	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum polyschistum	*Erythrosperma*		+	Safavi et al. (2013)
Taraxacum polyschistum	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum polyxanthum	*Boreigena*		+	Richards and Sell (1976)
Taraxacum potaninii	*Qaisera*	+		Ge et al. (2011)
Taraxacum praecox	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum praesigne	*Celtica*	+		Galán de Mera (2015)
Taraxacum praestabile	*Ruderalia*		+	Trávníček et al. 2008
Taraxacum praestans	*Spectabilia*	+		Richards and Sell (1976)
Taraxacum praestans	*Spectabilia*	+		Richards and Sell (1976)
Taraxacum przevalskii	*Tibetana*	+		Ge et al. (2011)
Taraxacum primigenium	*Rhodotricha*	+		Safavi et al. (2013)
Taraxacum privum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum proniobum	*Ruderalia*		+	Trávníček et al. (2007)
Taraxacum protractifolium	*Qaisera*	+		Ge et al. (2011)
Taraxacum proximiforme	*Erythrosperma*	+		Richards and Sell (1976)
Taraxacum proximum	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum prumicolor	*Erythrosperma*		+	Schmid et al. 2004
Taraxacum pseudoatratum	*Atrata*	+		Ge et al. (2011)
Taraxacum pseudocastaneum	*Erythrosperma*	+		Richards and Sell (1976)
Taraxacum pseudo-dissimile	*Erythrocarpa*		+	Safavi et al. (2013)

Taraxacum pseudo-dissimile forma	*Erythrocarpa*		+	Safavi et al. (2013)
Taraxacum pseudohamatum	*Hamata*		+	Trávníček and Vašut (2011)
Taraxacum pseudolacistophyllum	*Erythrosperma*	+		Richards and Sell (1976)
Taraxacum pseudoleucanthum	*Leucantha*			Ge et al. (2011)
Taraxacum pseudominutilobum	*Qaisera*	+		Ge et al. (2011)
Taraxacum pseudonutans	*Calanthodia*	+		Ge et al. (2011)
Taraxacum pseudosumneviczii	*Suavia*	+		Ge et al. (2011)
Taraxacum pubens	*Orientalia*	+		Safavi et al. (2013)
Taraxacum puberulum	*Qaisera*	+		Ge et al. (2011)
Taraxacum purpurei-petiolatum	*Erythrocarpa*		+	Safavi et al. (2013)
Taraxacum purpureomarginatum	*Erythrosperma*	+		Richards and Sell (1976)
Taraxacum purpuridens	*Spectabilia*	+		Richards and Sell (1976)
Taraxacum pycnolobum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum pycnostictum	*Spectabilia*	+		Richards and Sell (1976)
Taraxacum pyrenaicum	*Alpina*		+	Galán de Mera (2015)
Taraxacum pyropappum	*Dioszegia*	+		Galán de Mera (2015)
Taraxacum pyropappum	*Serotina*		+	Richards and Sell (1976)
Taraxacum qirae	*Borealia*	+		Ge et al. (2011)
Taraxacum quadrans	*Hamata*		+	Trávníček and Vašut (2011)
Taraxacum quettacum	*Leucantha*	+		Abedin 2007
Taraxacum raunkiaeri	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum rawalpindicum	*Parvula*	+		Abedin 2007
Taraxacum rechingeri	*Orientalia*	+		Safavi et al. (2013)
Taraxacum reclinatum	*Spectabilia*	+		Richards and Sell (1976)
Taraxacum recurvum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum reichenbachii	*Arctica*	+		Richards and Sell (1976)
Taraxacum remotijugum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum reophilum	*Alpestria*	+		Richards and Sell (1976)
Taraxacum repletum	*Spectabilia*	+		Richards and Sell (1976)
Taraxacum retroflexum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum rhaeticum	*Alpestria*	+		Richards and Sell (1976)
Taraxacum rhamphodes	*Ruderalia*		+	Trávníček et al. (2007)
Taraxacum rhodolepis	*Spectabilia*	+		Richards and Sell (1976)
Taraxacum rhodopodum	*Taraxacum*		+	Ge et al. (2011)
Taraxacum rhodopodum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum rigidifolium	*Ruderalia*		+	Snock,1999
Taraxacum roborovskyi	*Borealia*	+		Ge et al. (2011)

Taraxacum roseocarpum	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum roseoflavescens	*Tibetana*	+		Ge et al. (2011)
Taraxacum roseum	*Spuria*		+	Safavi et al. (2013)
Taraxacum rubicundum	*Erythrosperma*		+	Richards and Sell (1976);Galán de Mera (2015)
Taraxacum rubrisquameum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum rubrolineatum	*Boreigena*		+	Richards and Sell (1976)
Taraxacum rufocarpum	*Alpestria*	+		Richards and Sell (1976)
Taraxacum russum	*Erythrocarpa*			Ge et al. (2011)
Taraxacum saasense	*Alpina*	+		Richards and Sell (1976)
Taraxacum sagittifolium	*Spectabilia*	+		Richards and Sell (1976)
Taraxacum sagittipotens	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum sahlinianum	*Hamata*		+	Dudman and Richards (1994)
Taraxacum saphycraspedum	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum scanicum	*Erythrosperma*	+		Ge et al. (2011)
Taraxacum scanicum	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum scariosum	*Stenoloba*	+		Ge et al. (2011)
Taraxacum scaturiginosum	*Palustria*	+		Richards and Sell (1976)
Taraxacum schizophyllum	*Erythrosperma*	+		Richards and Sell (1976)
Taraxacum schroeteranum	*Rhodocaroa*	+		Richards and Sell (1976); Galán de Mera (2015)
Taraxacum scotiniforme	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum scotinum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum sellandii	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum semiglobosum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum septentrionale	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum serotinum	*Serotina*		+	Safavi et al. (2013)
Taraxacum serotinum	*Serotina*		+	Richards and Sell (1976)
Taraxacum sherriffii	*Emodensia*	+		Ge et al. (2011)
Taraxacum shikotanense	*Borealia*	+		Morita (1995)
Taraxacum sikkimense	*Emodensia*	+		Ge et al. (2011)
Taraxacum silesiacum	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum simile	*Erythrosperma*	+		Richards and Sell (1976)
Taraxacum simulans	*Qaisera*	+		Ge et al. (2011)
Taraxacum sinicum	*Leucantha*	+		Ge et al. (2011)
Taraxacum sinomongolicum	*Stenoloba*	+		Ge et al. (2011)
Taraxacum sinotianschanicum	*Atrata*	+		Ge et al. (2011)

Taraxacum siphonanthum	*Mongolica*	+		Ge et al. (2011)
Taraxacum spadiceum	*Dissecta*	+		Ge et al. (2011)
Taraxacum speciosum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum spectabile	*Spectabilia*	+		Richards and Sell (1976)
Taraxacum spilophyllum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum spinulosum	*Erythrocarpa*		+	Safavi et al. (2013)
Taraxacum stanjukoviczii	*Macrocornuta*	+		Safavi et al. (2013)
Taraxacum staticifolium	*Tibetana*	+		Ge et al. (2011)
Taraxacum starmuehleri	*Erythrosperma*	+		Uhlemann 2007
Taraxacum stenoceras	*Emodensia*	+		Ge et al. (2011)
Taraxacum stenolepium	*Orientalia*	+		Safavi et al. (2013)
Taraxacum stenoschistum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum stenospermum	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum stereodes	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum stictophyllum	*Spectabilia*	+		Richards and Sell (1976)
Taraxacum suavissimum	*Tibetana*	+		Ge et al. (2011)
Taraxacum subcalanthodium	*Qaisera*	+		Ge et al. (2011)
Taraxacum subcanescens	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum subcontristans	*Qaisera*	+		Ge et al. (2011)
Taraxacum subcyanolepis	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum subdissimile	*Erythrosperma*	+		Richards and Sell (1976)
Taraxacum subecornicolatum	*Erythrocarpa*	+		Safavi et al. (2013)
Taraxacum suberiopodum	*Tibetana*	+		Ge et al. (2011)
Taraxacum subglaciale	*Atrata*	+		Ge et al. (2011)
Taraxacum subintegrum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum sublaciniosum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum sublaeticolor	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum sublimiforme	*Ruderalia*		+	Sonck,1999
Taraxacum submicrocranum	*Erythrosperma*		+	Sonck,1999
Taraxacum subpraticola	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum subundulatum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum suecicum	*Palustria*	+		Richards and Sell (1976)
Taraxacum sulger-bueelii	*Cucullata*	+		Richards and Sell (1976)
Taraxacum sundbergii	*Ruderalia*		+	Galán de Mera (2015);Richards and Sell (1976)
Taraxacum syriacum Boiss.	*Spuria*	+		Safavi et al. (2013)
Taraxacum syrtorum	*Oligantha*	+		Ge et al. (2011)

Taraxacum taeniatum	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum tanyolobum	*Erythrosperma*	+		Richards and Sell (1976)
Taraxacum tarraconense	*Dioszegia*		+	Galán de Mera (2015)
Taraxacum tenebricans	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum tenuilobum	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum teres	*Arctica*		+	Galán de Mera (2015)
Taraxacum theodori	*Ruderalia*		+	Lundevall and Øllgaard (2006)
Taraxacum thracicum	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum tibetanum	*Tibetana*	+		Ge et al. (2011)
Taraxacum tiroliense	*Cucullata*	+		Richards and Sell (1976)
Taraxacum tonsum	*Qaisera*	+		Ge et al. (2011)
Taraxacum tornense	*Ceratophora*	+		Richards and Sell (1976)
Taraxacum tortilobum	*Erythrosperma*	+		Richards and Sell (1976)
Taraxacum transjordanensis	*Erythrocarpa*		+	Safavi et al. (2013)
Taraxacum triangulare	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum triforme	*Celtica*	+		Galán de Mera (2015)
Taraxacum trigonense	*Ruderalia*		+	Snock,1999
Taraxacum trigonolobum	*Borealia*	+		Morita (1995)
Taraxacum trilobatum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum turfosum	*Palustria*	+		Richards and Sell (1976)
Taraxacum turiense	*Arctica*	+		Richards and Sell (1976)
Taraxacum turritum	*Turrita*	+		Ge et al. (2011)
Taraxacum udum	*Palustria*	+		Richards and Sell (1976)
Taraxacum undulatiforme	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum undulatum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum unguilobum	*Spectabilia*	+		Richards and Sell (1976)
Taraxacum urbicola	*Ruderalia*		+	Trávníček et al. (2008)
Taraxacum vagum	*Spuria*		+	Safavi et al. (2013)
Taraxacum variegatum	*Mongolica*	+		Ge et al. (2011)
Taraxacum vastisectum	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum vendibile	*Parvula*	+		Ge et al. (2011)
Taraxacum venustum H.Koidz	*Borealia*	+		Morita (1995)
Taraxacum venustum Dahlst	*Alpina*	+		Richards and Sell (1976)
Taraxacum vetteri	*Alpina*	+		Richards and Sell (1976)
Taraxacum vindobonense	*Palustria*	+		Richards and Sell (1976)
Taraxacum vinosum	*Erythrosperma*		+	Galán de Mera (2015)
Taraxacum vinosum	*Erythrosperma*		+	Richards and Sell (1976)

Taraxacum violaceifrons	*Ruderalia*		+	Trávníček et al. (2007); Trávníček et al. (2008)
Taraxacum xanthiense	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum xanthostigma	*Taraxacum*		+	Richards and Sell (1976)
Taraxacum xerophilum	*Erythrosperma*		+	Richards and Sell (1976)
Taraxacum xinyuanicum	*Qaisera*	+		Ge et al. (2011)
Taraxacum yinshanicum	*Taraxacum*		+	Ge et al. (2011)
Taraxacum yuparense	*Borealia*	+		Morita (1995)
Taraxacum zagorae	*Ruderalia*		+	Snock1999
Taraxacum zamarrudae	*Oligantha*	+		Abedin 2007