Pest risk analysis on *Taraxum koksaghyz*

Issued by: Julius Kühn-Institut, Institute for National and International Plant Health, December 2013.
Responsible staff member: Dr. Uwe Starfinger, commented by Sarah Brunel and Gritta Schrader

Stage 1: Initiation

Stage 2: Pest Risk Assessment Section A: Pest categorization

Stage 2: Pest Risk Assessment Section B: Probability of entry of a pest

Stage 2: Pest Risk Assessment Section B: Probability of establishment

Stage 2: Pest Risk Assessment Section B: Conclusion of introduction

Stage 2: Pest Risk Assessment Section B: Probability of spread

Stage 2: Pest Risk Assessment Section B: Eradication, containment of the pest and transient populations

Stage 2: Pest Risk Assessment Section B: Assessment of potential economic consequences

Stage 2: Pest Risk Assessment Section B: Degree of uncertainty and Conclusion of the pest risk assessment

Stage 3: Pest Risk Management

Stage 1: Initiation

1.01 - Give the reason for performing the PRA

Other reason

1.01b - If other reason, specify

The plant has been used in the past for the production of rubber in temperate climate. This use was due to rubber shortage particularly in war times. Because of low productivity this was discontinued after WW II. In recent times, interest has focused again on the plant and its use for rubber production.

This PRA was initiated before planting larger amounts of the species in order to examine the potential danger of its becoming invasive.

1.02a - Name of the pest

Taraxacum koksaghyz Rodin; Russischer Löwenzahn, Rubber Dandelion. Synonyms: *T. bicorne*,

1.02b - Indicate the type of the pest

Non parasitic plant

1.02d - Indicate the taxonomic position

Magnoliophyta

Asterales

Asteraceae

1.03 - Clearly define the PRA area

NE-Germany: Federal States of Mecklenburg-Vorpommern, Brandenburg and Berlin. Currently there are plans for trial plantations of *T. koksaghyz* in this region. The results of the PRA may not be valid for other parts of Germany or for other countries.

1.04 - Does a relevant earlier PRA exist?

no

A PRA was developed by the Canadian Food Inspection Agency (CFIA 2011). It does not follow the EPPO scheme and was done for North America.

1.06 - Specify all host plant species (for pests directly affecting plants) or suitable habitats (for non parasitic plants). Indicate the ones which are present in the PRA area.

The species occurs in well-drained, moist soils in open or half-shady conditions (Ulmann 1951).

1.07 - Specify the pest distribution for a pest initiated PRA, or the distribution of the pests identified in 2b for pathway initiated PRA

The natural range is in Kazakhstan where the species is found in grasslands at elevations of 1800 - 2100 m asl (Ulmann 1951). It is also reported from western China and Kyrgyzstan (CFIA 2011).

The species has been cultivated in several parts of the world, e.g., Russia, Germany, North America and is reported to occur locally in some countries like Austria, Czechoslovakia, Germany, Hungary, Romania, and western

Russia etc. (CFIA 2011).

The German Flora database (floraweb), however, does not list the species and it is not listed as occurring in Germany in Buttler et al. (2012). It is also not mentioned as occurring in Germany by Uhlemann (2001).

Stage 2: Pest Risk Assessment Section A: Pest categorization

Identity of the pest (or potential pest)

1.08 - Does the name you have given for the organism correspond to a single taxonomic entity which can be adequately distinguished from other entities of the same rank?

yes

Taraxacum taxonomy is complex. Species' ranks are often used differently by different authors (e.g., Brouillet 2006).

In germplasm collections, many of the supposed *T. koksaghyz* were in fact *T. brevicorniculatum* (Kirschner et al. 2012).

1.10 - Is the organism in its area of current distribution a known pest (or vector of a pest) of plants or plant products?

no

The plant invades into agricultural fields in its native area, but reports of impacts are lacking.

1.11 - Does the organism have intrinsic attributes that indicate that it could cause significant harm to plants?

yes or uncertain (the organism may become a pest in the PRA area)

The plant may easily spread and effects are difficult to predict. In particular, the possibility of hybridizing with native *Taraxacum* species needs to be addressed.

1.12 - Does the pest occur in the PRA area?

no

Even though it was stated sometimes (CFIA 2011), German Flora lists deny its occurrence outside cultivation in Germany (Buttler et al. 2012).

1.14 - Does at least one host-plant species (for pests directly affecting plants) or one suitable habitat (for non parasitic plants) occur in the PRA area (outdoors, in protected cultivation or both)?

yes

The plant can grow in open vegetation like meadows which abound in the PRA area.

1.15a - Is transmission by a vector the only means by which the pest can spread naturally?

no

The plant can easily spread by seeds.

1.16 - Does the known area of current distribution of the pest include ecoclimatic conditions comparable with those of the PRA area or sufficiently similar for the pest to survive and thrive (consider also protected conditions)?

yes

The plant was planted successfully in regions with different climates.

1.17 - With specific reference to the plant(s) or habitats which occur(s) in the PRA area, and the damage or loss caused by the pest in its area of current distribution, could the pest by itself, or acting as a vector, cause significant damage or loss to plants or other negative economic impacts (on the environment, on society, on export markets) through the effect on plant health in the PRA area?

uncertain

Effects of hybridization need to be considered.

This pest could present a phytosanitary risk to the PRA area.

1.18 - Summarize the main elements leading to this conclusion.

The plant is likely to be able to grow and to disperse in the PRA area. Probability of damage to plants seems low but hybridization with native plants may be detrimental.

Stage 2: Pest Risk Assessment Section B: Probability of entry of a pest

2.01a - Describe the relevant pathways and make a note of any obvious pathways that are impossible and record the reasons. Explain your judgement

Introduction as a plant for rubber production.

2.01b - List the relevant pathways that will be considered for entry and/or management. Some pathways may not be considered in detail in the entry section due to lack of data but will be considered in the management part.

Deliberate introduction

Pathway 1: **Deliberate introduction**

2.03 - How likely is the pest to be associated with the pathway at the point(s) of origin taking into account the biology of the pest?

very likely

Level of uncertainty: low

Deliberate introduction.

2.04 - How likely is the pest to be associated with the pathway at the point(s) of origin taking into account *current management* conditions?

very likely

Level of uncertainty: low

Deliberate introduction

2.05 - Consider the volume of movement along the pathway (for periods when the pest is likely to be associated with it): how likely is it that this volume will support entry?

very likely

Level of uncertainty: low

Deliberate introduction

2.06 - Consider the frequency of movement along the pathway (for periods when the pest is likely to be associated with it): how likely is it that this frequency will support entry?

very likely

Level of uncertainty: low

Deliberate introduction

2.07 - How likely is the pest to survive during transport or storage?

very likely

Level of uncertainty: low

Deliberate introduction

2.08 - How likely is the pest to multiply/increase in prevalence during transport or storage?

very unlikely

Level of uncertainty: low

Seed transport

2.09 - Under current inspection procedures how likely is the pest to enter the PRA area undetected?

very likely

Level of uncertainty: low

Deliberate introduction

2.10 - How likely is the pest to be able to transfer from the pathway to a suitable host or habitat ?

moderately likely

Level of uncertainty: medium

Seeds are wind-dispersed and are estimated to travel c. 500m.

2.11 - The probability of entry for the pathway should be described

very likely

Level of uncertainty: low

Deliberate introduction

2.13b - Describe the overall probability of entry taking into account the risk presented by different pathways and estimate the overall likelihood of entry into the PRA area for this pest (comment on the key issues that lead to this conclusion).

very likely

Level of uncertainty: low

Deliberate introduction

Stage 2: Pest Risk Assessment Section B: Probability of establishment

In a first step, assessors should select the ecological factors that influence the potential for establishment.

Seven factors may influence the limits to the area of potential establishment and the suitability for establishment within this area:

1 - Host plants and suitable habitats

2 - Alternate hosts and other essential species

3 - Climatic suitability

4 - Other abiotic factors

5 - Competition and natural enemies

6 - The managed environment

7 - Protected cultivation

No.	Factor	Is the factor likely to have an influence on the limits to the area of potential establishment?	Is the factor likely to have an influence on the suitability of the area of potential establishment?	Justification
1	Host plants and suitable habitats (see note for Q3.01)	Yes (see 3.01)	Yes (see 3.09)	
2	Alternate hosts and other essential species	No	No	No other species limit the occurrence. The plants are pollinated is by several insect species, including honeybees and other bees (Ulmann 1951; CFIA 2011) and some fly species (Suomela 1950). A number of other insects, such as beetles, ants and other hymenopterans can

No.	Factor	Is the factor likely to have an influence on the limits to the area of potential establishment?	Is the factor likely to have an influence on the suitability of the area of potential establishment?	Justification
				pollinate the flowers (Ulmann 1951). Sometimes it can be self pollinated (Warmke 1944).
3	Climatic suitability	Yes (see 3.03)	Yes (see 3.11)	
4	Other abiotic factors	No	Yes (see 3.12)	The plant is able to grow in a range of soils and habitats.
5	Competition and natural enemies	No	Yes (see 3.13)	The species is a poor competitor. Competitors may be found in the whole PRA area
6	The managed environment	No	Yes (see 3.14 / 3.15)	Managed environment is not restricted to parts of the PRA area
7	Protected cultivation	No	No	The species is not expected to occur in protected cultivation

Host plants and suitable habitats

3.01 - Identify and describe the area where the host plants or suitable habitats are present in the PRA area outside protected cultivation.

Suitable habitats include open, disturbed vegetation on moist soils. They are present in most of the PRA area.

Alternate hosts and other essential species
Climatic suitability

3.03 - Does all the area identified as being suitable for establishment in previous question(s) have a suitable climate for establishment?

Yes (Based on the area assessed as being suitable for establishment in previous questions, identify and describe the area where the climate is similar to that in the pest's current area of distribution. Describe how this affects the area identified where hosts, suitable habitats and other essential species are present.)

In the native range the climate is continental with cold winters and hot summers (Ulmann 1951), in spring the daily variation of temperatures can be large with night temperature of 0-4°C and day temperatures of 30-50°C. Precipitation averages 250-300 mm annually, with dry summers. The plant grows best when the soil in spring is wet from melting snows.

In NE-Germany these conditions are met over most of the area. Temperatures and precipitation are less extreme than in the native range. In dryer parts of NE-Germany, spring moisture may limit the growth of the species.

Other abiotic factors
Competition and natural enemies
The managed environment
Protected Cultivation

3.08 - By combining the cumulative responses to previous questions with the response to question 3.07, identify the part of the PRA area where the presence of host plants or suitable habitats and other factors favour the establishment of the pest.

NE-Germany with the possible exception of the driest parts.

Host plants and suitable habitats

3.09 - How likely is the distribution of hosts or suitable habitats in the area of potential establishment to favour establishment?

likely

Level of uncertainty: medium

Open disturbed vegetation occurs in large extents in NE-Germany.

Alternate hosts and other essential species
Climatic suitability

3.11 - Based on the area of potential establishment already identified, how similar are the climatic conditions that would affect pest establishment to those in the current area of distribution?

largely similar

Level of uncertainty: low

In the native range, the plant occurs at high elevations (1800 - 2000 m) in Kazakhstan, Kyrgysztan and W, China. It has been successfully cultivated in many countries with different climates and has escaped cultivation in several. They include Austria, Germany, Finland, USA, Australia.

Other abiotic factors

3.12 - Based on the area suitable for establishment already identified, how similar are other abiotic factors that would affect pest establishment to those in the current area of distribution?

largely similar

Level of uncertainty: low

The species is described as highly adaptable to soil types (Whaley 1944).

Competition and natural enemies

3.13 - Based on the area suitable for establishment already identified, how likely is it that establishment will occur despite competition from existing species, and/or despite natural enemies already present?

unlikely

Level of uncertainty: high

Little information is available on the species' behaviour in its non-native range. However in E. Asia it is said to invade cultivated fields (Krotkov 1945). It may occur in sparse vegetation with little competition. However, establishment outside cultivation has not been observed in many countries where it has been planted.

The managed environment

3.14 - How favourable for establishment is the managed environment in the area of potential establishment?

moderately favourable

Level of uncertainty: medium

From guidance:

The time of the year that the relevant crop is grown and its phenology are congruent with the life cycle of the pest

The relevant crop is grown under protected conditions

The crop are cultivated in monoculture (or the hosts are perennial plants)

Soil preparation has no influence on the establishment of the pest

The method or type of planting has no influence on the establishment of the pest

Other practice(s) has (have) no influence on the establishment

Not relevant

The time or method of harvest has no influence on the establishment of the pest

Not relevant

artificial fire regimes have no influence establishment of the pest

construction activities and management road sides have no influence on pest establishment

The pest is not a pest plant or management of water courses has no influence the establishment of the pest plant

3.15 - How likely is the pest to establish despite existing pest management practice?

moderately likely

Level of uncertainty: high

Weed management may hinder it from invading agricultural fields. But invasion into ruderal vegetation is also possible.

Protected Cultivation

3.17 - How likely are the reproductive strategy of the pest and the duration of its life cycle to aid establishment?

very likely

Level of uncertainty: low

The species behaves as a perennial in its natural range but can be grown as an annual or biennial. Flowering may begin after 60 - 70 days from sowing (Krotkov 1945).

3.18 - Is the pest highly adaptable?

Yes, highly or very highly adaptable

Level of uncertainty: low

The plant is reported to be adaptable to different soil types and can occur in different growth forms (annual, perennial, biennual).

3.19 - How widely has the pest established in new areas outside its original area of distribution? (specify the instances, if possible; note that if the original area is not known, answer the question only based on the countries/continents where it is known to occur)

widely

Level of uncertainty: medium

The plant is supposed to be established in Australia (Tasmania) and Europe (CFIA 2011).

3.20 - The overall probability of establishment should be described.

low

Level of uncertainty: high

The plant has naturalized outside its native range but in many countries where it has been planted establishment in the wild was not reported.

Stage 2: Pest Risk Assessment Section B: Conclusion of introduction

c1 - Conclusion on the probability of introduction.

While entry is very likely because of plans to cultivate the plant for rubber production, chances for establishment outside of cultivation are more difficult to estimate. There are reports on establishment of the species in several countries, however, no populations seem to exist in Germany, even after a period of its cultivation in the 1940s.

Stage 2: Pest Risk Assessment Section B: Probability of spread

Spread is defined as the expansion of the geographical distribution of a pest within an area. Spread potential is an important element in determining how quickly impact is expressed and how readily a pest can be contained. In the case of intentionally imported plants, the assessment of spread concerns spread from the intended habitat or the intended use to an unintended habitat, where the pest may establish. Further spread may then occur to other unintended habitats. The nature and extent of the intended habitat and the nature and amount of the intended use in that habitat will also influence the probability of spread. Some pests may not have injurious effects on plants immediately after they establish, and in particular may only spread after a certain time. In assessing the probability of spread, this should be considered, based on evidence of such behaviour.

In the PRATIQUE project, spread modules have been investigated. To decide whether it is appropriate to try to use these modules, please follow this link " quantitative spread module **" (only available when online)**

4.01 - What is the most likely rate of spread by natural means (in the PRA area)?

low rate of spread

Level of uncertainty: medium

Dispersal over more than 1km per year seems unlikely, even though the seeds are wind-dispersed.

4.02 - What is the most likely rate of spread by human assistance (in the PRA area)?

high rate of spread

Level of uncertainty: high

The pathway is the deliberate movement of the plant for planting. Its frequency cannot now be estimated.

4.03 - Describe the overall rate of spread

high rate of spread

Level of uncertainty: high

As stated in the section on human mediated dispersal.

4.04 - What is your best estimate of the time needed for the pest to reach its maximum extent in the PRA area?

Level of uncertainty: high

This cannot be estimated since the spread will mainly depend on the use of the plant in agriculture.

4.05 - Based on your responses to questions 4.01, 4.02, and 4.04 while taking into account any current presence of the pest, what proportion of the area of potential establishment do you expect to have been invaded by the organism after 5 years?

Level of uncertainty: medium

It is estimated that within 5 years the use of the plant in agriculture will not be copious and the area with the plant will be very small.

Stage 2: Pest Risk Assessment Section B: Eradication, containment of the pest and transient populations

5.01 - Based on its biological characteristics, how likely is it that the pest could survive eradication programmes in the area of potential establishment?

moderately likely

Level of uncertainty: medium

The species seems a poor competitor and is sensitive to weed management in fields where it is cultivated (Jacobson 1952).

5.02 - Based on its biological characteristics, how likely is it that the pest will not be contained in case of an outbreak within the PRA area ?

moderately likely

Level of uncertainty: medium

see above

5.03 - Are transient populations likely to occur in the PRA area through natural migration or entry through man's activities (including intentional release into the environment) or spread from established populations?

Yes

Level of uncertainty: low

Spread from cultivated populations is very likely.

Stage 2: Pest Risk Assessment Section B: Assessment of potential economic consequences

6.01 - How great a negative effect does the pest have on crop yield and/or quality of cultivated plants or on control costs within its current area of distribution?

minimal

Level of uncertainty: medium

In its native range, the plant is known to occur as a minor weed in agricultural fields (Krotkov 1945).

6.02 - How great a negative effect is the pest likely to have on crop yield and/or quality of cultivated plants in the PRA area without any control measures?

minimal

Level of uncertainty: medium

The plant is not known as a weed in agriculture.

6.03 - How great a negative effect is the pest likely to have on yield and/or quality of cultivated plants in the PRA area without any additional control measures?

minimal

Level of uncertainty: medium

see above

6.04 - How great a negative effect is the pest likely to have on yield and/or quality of cultivated plants in the PRA area when all potential measures legally available to the producer are applied, without phytosanitary measures?

minimal

Level of uncertainty: medium

see above

6.05 - How great an increase in production costs (including control costs) is likely to be caused by the pest in the PRA area in the absence of phytosanitary measures?

minimal

Level of uncertainty: medium

see above

6.06 - Based on the total market, i.e. the size of the domestic market plus any export market, for the plants and plant product(s) at risk, what will be the likely impact of a loss in export markets, e.g. as a result of trading partners imposing export bans from the PRA area?

minimal

Level of uncertainty: medium

see above

6.07 - To what extent will direct impacts be borne by producers?

minimal extent

Level of uncertainty: medium

see above

In this section, the different questions will help the assess or to rate the environmental impact within the current area of distribution of the pest (Q6.08).

This information is used as an indicator for determining the potential environmental impact in the PRA area (Q6.09).

6.08.0A - Do you consider that the question on the environmental impact caused by the pest within its current area of invasion can be answered? (Read the note)

No but information is available for the native area of the plant

6.08 - How important is the environmental impact caused by the pest within its current area of invasion?

Minor

Level of uncertainty: medium

The species can invade agricultural fields in its native area but the impacts were not quantified. Impacts of the species in the trial plantations in many European, Asian and North American countries have not been reported. It can be assumed that the plant does not pose a large risk of damaging other plants (cf. CFIA 2011).

Negative impact on native biodiversity

Note: **The word "native" in "native species" or "native biodiversity" throughout Questions 6.08 and 6.09 should be understood in a broad sense, i.e. it should also include species that have been naturalised for centuries and that play an important role in the ecosystems or local cultural heritage, such as walnut (*Juglans*) or chestnut (*Castanea*) in Europe. The assessor may also include other, more recently introduced beneficial organisms such as exotic plants that play a role in ecosystem services, e.g. plants used against erosion.**

6.08.01 - To what extent does the plant cause a decline in native species populations and changes in communities of native species?

Low extent

Level of uncertainty: medium

Not reported and not expected.

6.08.02 - To what extent does the plant hybridize with native species?

Medium extent

Level of uncertainty: high

In the genus *Taraxacum* species with different chromosome numbers and with different types of sexuality occur. Hybrids between species can be fertile, in particular those between sexual species with the same

ploidy level (Richards 1970). In western and boreal Europe mainly apomictic species of *Taraxacum* occur, in Asia and the Mediterranean there are mostly sexual species (Richards 1970). Hybrids between diploid sexual species and triploid apomictic species were generally less fertile but viable seed set was possible (Tas & van Dyke 1999). Hybrids with *T. offinale* were reported to be male sterile (Malecka 1971).

Hybridization can result in 2 types of threat: a) a new genotype may develop that is superior in competition than its parent species through heterosis (eg, *Fallopia* x *bohemica* is a better competitor than its parents). In apomictic species of *Taraxacum*, a rare event of receiving alien pollen may at once lead to a new apomictic taxon (cf. Uhlemann 2002).

b) Introgression of genes into a native species may lead a contamination of the native's gene pool with unknown effects (e.g., bluebells, *Hyacinthoides nonscripta*). The impact may be bigger in threatened or rare species that may lose their adaptation to specific ecological conditions. Chances to predict the severity of this threat depend on the knowledge of potential partners.

Alteration of ecosystem patterns and processes

6.08.03 - To what extent does the plant cause physical modifications of habitats (e.g. changes to the hydrology, significant increase of water turbidity, light interception, alteration of river banks, changes in fire regime, etc.)?

Low extent

Level of uncertainty: medium

Not reported and not expected due to the small size of the plant.

6.08.04 - To what extent does the plant cause changes to nutrient cycling and availability (e.g. significant changes in nutrient pools in topsoils or in water)?

Low extent

Level of uncertainty: medium

Not reported and not expected due to the small size and low densisties of the plant.

6.08.05 - To what extent does the plant cause modifications of natural successions (e.g. acceleration or temporary freezing of successions)?

Low extent

Level of uncertainty: medium

Not reported and not expected due to the low competitive ability.

6.08.06 - To what extent does the plant disrupt trophic and mutualistic interactions (e.g. through the alteration of pollinator visitations - leading to a decrease in the reproductive success of native species-, allelopathic interactions, strong reduction of phytophagous or saprophagous communities, etc.)?

Low extent

Level of uncertainty: medium

Not reported and not expected due to the small size of the plant.

Conservation impacts

6.08.07 - To what extent does the plant occur in habitats of high conservation value (includes all officially protected nature conservation habitats)?

Medium extent

Level of uncertainty: medium

The plant generally occurs in open vegetation and may invade dry grasslands of some conservation value.

6.08.08 - To what extent does the plant threaten rare or vulnerable species (includes all species classified as rare, vulnerable or endangered in official national or regional lists within the PRA area)?

Low extent

Level of uncertainty: medium

Threat has not been observed and is not likely to occur due to small size and low competitive ability.

6.09.0a - Taking into account the responses to the relevant questions (on hosts and habitats, climatic conditions, abiotic factors, management methods) in the establishment section, are the conditions in the PRA area sufficiently similar to those in the area of invasion to expect a similar level of impact?

yes

Level of uncertainty: medium

Vegetation is relatively similar so the impacts are expected to be similar, too.

6.09.0b - Does the same native species or community, or the same threatened ecosystem services, occur in the PRA area and, if not, is it known whether the native species or communities, or ecosystem service in the PRA area are similarly and significantly susceptible?

yes

Level of uncertainty: medium

see above

6.09 - How important is the environmental impact likely to be in the PRA area?

Moderate

Level of uncertainty: medium

The competitive ability of the species is not well known. However, given the trial plantations in many European, Asian and North American countries and the lack of reports of the species becoming invasive, it can be assumed that the plant does not pose a large risk of damaging other plants (cf. CFIA 2011).

A risk lies in the hybridization with other *Taraxacum* species: Hybridization within *Taraxacum* is known to occur. Many *Taraxacum* species exist in the German Flora, some of which are threatened, rare or endangered (e.g. LfU 2010).

6.10 - How important is social damage caused by the pest within its current area of distribution?

minimal

Level of uncertainty: medium

No social damage is reported or expected.

6.11 - How important is the social damage likely to be in the PRA area?

minimal

Level of uncertainty: medium

No social damage is reported or expected.

6.12 - To what extent is the pest likely to disrupt existing biological or integrated systems for control of other pests?

minimal

Level of uncertainty: low

None expected.

6.13 - How great an increase in other costs resulting from introduction is likely to occur?

minimal

Level of uncertainty: low

None expected.

6.14 - How great an increase in the economic impact of other pests is likely to occur if the pest can act as a vector or host for these pests or if genetic traits can be carried to other species, modifying their genetic nature?

minimal

Level of uncertainty: low

None expected.

6.15a - Describe the overall economic impact (sensus stricto)

minimal

Level of uncertainty: medium

see above

6.15b - With reference to the area of potential establishment identified in Q3.08, identify the area which at highest risk from economic, environmental and social impacts. Summarize the impact and indicate how these may change in future.

minor

Level of uncertainty: medium

No impacts have been recorded. The plant is a week competitor. Some uncertainty lies in the fact that hybridization is possible but its impact cannot be estimated.

Stage 2: Pest Risk Assessment Section B: Degree of uncertainty and Conclusion of the pest risk assessment

c2 - Degree of uncertainty : list sources of uncertainty

Because of successful cultivation in different climates it seems likely with little uncertainty that the plant will be able to grow in the PRA area. There is also little uncertainty that spread of the wind-dispersed seeds will occur.

Medium uncertainty exists about the ability of the plant to establish outside of cultivation.

Hybridization is not likely to occur in NE-Germany, but can occur in other regions. Its effect cannot be estimated with certainty.

c3 - Conclusion of the pest risk assessment

The risk of the species invading in the PRA is minor. Even if the plant should establish and spread, its effects on native biodiversity and/or cultivated plants are assumed to be minor (cf. CFIA 2011). In addition, outbreaks may be controlled.

Hybridization with native plants of the genus *Taraxacum*, while difficult to predict specifically, is a potential major threat to these species and cannot be reversed. This threat is judged as negligible for the PRA area, since no sexually reproducing *Taraxacum* species are reported from the area. A monitoring is recommended to follow the fate of *Taraxacum* species in the vicinity of the plantations.

Stage 3: Pest Risk Management

A decision has to be made to determine whether the risk from any pest/pathway combination is an acceptable risk. This decision will be based on the relationship between the level of risk identified in the pest risk assessment stage (i.e. the combination of the probability of introduction and the potential economic impact) and the importance/desirability of the trade that carries the risk of introduction of the pest.

7.01 - Is the risk identified in the Pest Risk Assessment stage for all pest/pathway combinations an acceptable risk?

yes

see above

7.02 - Is natural spread one of the pathways?

no

References

Brouillet L (2006): 37. *Taraxacum* F. H. Wiggers, Prim. Fl. Holsat. 56. 1780. In: Flora of North America Editorial Committee, eds. 1993+. Flora of North America North of Mexico. 16+ vols. New York and Oxford. http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=132314

Bayerisches Landesamt für Umwelt (2010): Merkblatt Artenschutz 22: Artengruppe Sumpf-LöwenzähneTaraxacum sect. Palustria (H. Lindb.) Dahlst. LfU, Augsburg. www.lfu.bayern.de

Canadian Food Inspection Agency (CFIA). 2011. RMD-11-05: Pest Risk Management Decision Document for *Taraxacum koksaghyz* (Russian dandelion) in Canada. CFIA, Ottawa, ON.

den Nijs H.C.M., Kirschner, J., Štěpánek, J. & van der Hulst, A. (1990): Distribution of diploid sexual plants of *Taraxacum* sect. Ruderalia in east-Central Europe, with special reference to Czechoslovakia. – Plant Syst. Evol. 170: 71–84.

Jacobson G (1952): Odlingstekniska försök med kautschukmaskros : resultat av försök med koksagys utförda av Statens jordbruksförsök under åren 1948-1951. Stockholm

Javorsky, L (1944): Die neue Kautschukpflanze Kok-Sagys und ihr Anbau in Sowjet-Russland. Tropenpflanzer 47, 1, 38-50

Jenniskens, M.P.J. (1984) Self-compatibility in diploid plants of *Taraxacum* section *Taraxacum*. Acta Bot. Neerl. 33, 155-164

Kirschner J, Stepanek J, Cerny T, de Heer P, van Dijk PJ (2012): Available ex situ germplasm of the potential rubber crop *Taraxacum koksaghyz* belongs to a poor rubber producer, *T. brevicorniculatum* (Compositae–Crepidinae). Genetic Resources and Crop Evolution 60 (2): 455-471

Krotkov, G. 1945. A review of literature on *Taraxacum koksaghyz* Rod. The Botanical Review 11(8): 417-461.

Malecka, J. 1971. Cyto-taxonomical and embryological investigations on a natural hybrid between *Taraxacum koksaghyz* Rodin and *T. officinale* Web. and their putative parent species. Acta Biol. Crac. Ser. Bot. 14: 179-197.

Mfirtonfiova Lenka 2006. Possible pathways of the gene flow in *Taraxacum* sect. Ruderalia. Folia Geobotanica 41. 183-201

Morita T, Sterk AA, Den Nijs JCM (1990b). The significance of agamospermous triploid pollen donors in the sexual relationships between diploids and triploids in *Taraxacum* (Compositae). Plant Spec Biol 5: 167?176

Richards, A. J. (1970b). Hybridisation in *Taraxacum*. New Phytol, 69: 1103–1121.

Schmid, M. (2003): Morphologie, Vergesellschaftung, Ökologie, Verbreitung und Gefährdung der Sumpf-Löwenzähne (*Taraxacum* sect. Palustria Dahlst., Asteraceae) Süddeutschlands. Bibliotheca Botanica. 155: IX, 268 S, Stuttgart

Suomela H (1950) On the possibilities of growing *Taraxacum koksaghyz* in Finland. State Agricultural Research Publications of Finland No 132, Helsinki

Tas, I. C. Q. & van Dijk, P. J. (1999): Crosses between sexual and apomictic dandelions (*Taraxacum*). I. The inheritance of apomixis. Heredity 83, 707–714; doi:10.1046/j.1365-2540.1999.00619.x

Uhlemann, I. 2001: Distribution of reproductive systems and taxonomical concepts in the genus *Taraxacum* F.H.Wigg. (Asteraceae, Lactuceae) in Germany. Feddes Repert. 112 (1-2): 15-35

Uhlemann, I. 2002: A new species of the genus *Taraxacum* F.H. Wigg. (Asteraceae, Lactuceae) from South America. - Feddes Repert. 113 (5-6): 329-334

Ulmann, M. 1951: Wertvolle Kautschukpflanzen des gemässigten Klimas. Akademie-Verlag, Berlin. 562 pp.

R. G. M. Van Der Hulst,T. H. M. Mes,J. C. M. Den Nijs,K. Bachmann 2001 Amplified fragment length polymorphism (AFLP) markers reveal that population structure of triploid dandelions (*Taraxacum officinale*) exhibits both clonality and recombination. Molecular Ecology 9

Whaley, W.G. and Bowen, J.S. 1947. Russian Dandelion (*koksaghyz*) An Emergency Source of Natural Rubber. U.S. Government Printing Office, Washington 25, D.C. 212 pp.