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Risk analysis relating to the giant ragweed (*Ambrosia trifida L.*) in order to formulate management recommendations

ANSES Opinion
Collective Expert Appraisal Report

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The Director General

Maisons-Alfort, 10 July 2017

OPINION[1]
of the French Agency for Food, Environmental and Occupational Health & Safety

on conducting a risk analysis relating to the giant ragweed (*Ambrosia trifida* L.) in order to formulate management recommendations

ANSES undertakes independent and pluralistic scientific expert assessments.
ANSES primarily ensures environmental, occupational and food safety as well as assessing the potential health risks they may entail.
It also contributes to the protection of the health and welfare of animals, the protection of plant health and the evaluation of the nutritional characteristics of food.

It provides the competent authorities with the necessary information concerning these risks as well as the requisite expertise and technical support for drafting legislative and statutory provisions and implementing risk management strategies (Article L.1313-1 of the French Public Health Code).

Its opinions are published on its website.
This opinion is a translation of the original French version. In the event of any discrepancy or ambiguity the French language text dated 10 July 2017 shall prevail.

On 25 April 2016, ANSES received a formal request from the Directorate General for Health, the Directorate General for Land-Use Planning, Housing & Nature, and the Directorate General for Food to undertake the following expert appraisal: risk analysis relating to the giant ragweed (*Ambrosia trifida* L.) in order to formulate management recommendations.

1. BACKGROUND AND PURPOSE OF THE REQUEST

On 22 October 2014, the European Parliament and the Council published a Regulation on the prevention and management of the introduction and spread of invasive alien species (IAS). This Regulation stipulates, in particular its Article 19, that Member States shall put in place effective management measures for a list of IAS of European Union (EU) concern, which, according to its Article 4, must be adopted by the European Commission in early 2016, by way of implementing acts. This list is to be regularly updated. The inclusion of a species on this list will therefore result in the implementation of preventive and control actions coordinated between the different Member States of the European Union, aimed at reducing the negative impact of these species, primarily on biodiversity and ecosystem services, as well as other possible negative impacts in the case of certain IAS that may affect human health and/or the economy.

For any species to be proposed for the above-mentioned future list, the European Commission must have a risk analysis complying with 14 standards it has specified in the report entitled "Invasive alien species – Framework for the identification of invasive alien species of EU concern.

[1] Cancels and replaces the Opinion of 23 June 2017
§ Entry adding the sentence "On the other hand, the intentional introduction of *Ambrosia trifida* seeds is unlikely, and is regulated in France by the Decree of 26 April 2017."

ENV.B.2/ETU/2013/0026, as well as five criteria defined in Article 4 of the Regulation. For some of the species listed in the above-mentioned report, risk analyses are already available. For any that are not listed and that a Member State would like to see proposed as part of the regular updating of the list (see Article 4), a risk analysis must be provided to the European Commission.

Among the plant species of the genus *Ambrosia* present in France, several are invasive alien species with a potential health impact since they release pollen that is highly allergenic for humans. This is particularly the case with common ragweed (*Ambrosia artemisiifolia* L.), giant ragweed (*Ambrosia trifida* L.) and western ragweed (*Ambrosia psilostachya* DC.). Although a risk analysis is available in the above-mentioned report for common ragweed (*Ambrosia artemisiifolia* L.), this is not the case for giant ragweed.

Giant ragweed is also one of the crop weeds that is most difficult to manage in its area of origin, as its size and growing cycle lead to strong competition with the existing vegetation. It was the subject of an ANSES alert sheet in 2013, and observations have confirmed its establishment in the Occitanie region (ex-Midi-Pyrénées region) within zones that suggest its control is still possible.

Moreover, this species is targeted by several actions of the Third National Environmental Health Action Plan (PNSE 3), in particular Action 11 aiming to better assess exposure to ragweed and monitor its geographical expansion, and Action 12 whose objective is to strengthen and coordinate the management of plant and animal species whose proliferation may be harmful to public health.

In this context and so as to be able to also propose this ragweed in a forthcoming revision of the above-mentioned European list, a risk analysis concerning *A. trifida* was carried out considering the entire European Union as the geographical area. This risk analysis had a risk assessment component including the impact on human health and the effects of climate change in the foreseeable future, and a risk management component, in accordance with the methodology recommended by the European Commission in the framework of the above-mentioned European Regulation.

In order to implement Action 12 of the PNSE 3, the expert appraisal also provided recommendations to strengthen the management of this species in France and improve the coordination of management actions already undertaken in this country.

2. ORGANISATION OF THE EXPERT APPRAISAL

The expert appraisal was carried out in accordance with French Standard NF X 50-110 "Quality in Expert Appraisals – General Requirements of Competence for Expert Appraisals (May 2003)".

The expert appraisal falls within the sphere of competence of the Expert Committee (CES) on "Biological risks for plant health". ANSES entrusted the expert appraisal to the Working Group on "Ragweed". The methodological and scientific aspects of the work were presented to the CES between the months of May 2016 and June 2017. The work was adopted by the CES on "Biological risks for plant health" at its meeting on 8 June 2017.

ANSES analyses interests declared by experts before they are appointed and throughout their work in order to prevent risks of conflicts of interest in relation to the points addressed in expert appraisals.
The experts' declarations of interests are made public via the ANSES website (www.anses.fr).

The model used for the collective expert appraisal report was the pest risk analysis (PRA) scheme of the European and Mediterranean Plant Protection Organization (EPPO)[2]. The expert appraisal was conducted following the pest risk analysis process, which is subdivided into three

[2] European and Mediterranean Plant Protection Organization (2011) PM 5/3(5) "Guidelines on Pest Risk Analysis. Decision-support scheme for quarantine pests"

interdependent stages: initiation, pest risk assessment (categorisation of the pest, assessment of the likelihood of introduction[3] and spread, assessment of the potential economic consequences), and pest risk management.

3. Analysis and conclusions of the CES

Conclusion of the pest risk assessment

Entry

The contamination of seed lots or of maize, soybean or sunflower seed for livestock feed or the agri-food industry, imported from the area of origin of *Ambrosia trifida* into the PRA area, is regarded as the main factor for the introduction of this species. In addition, the volumes involved have been consistently high over the past few years. These imports are not covered by any particular regulations or controls with regard to their potential contamination by seeds of *A*. *trifida*. The regular entry of seeds of *A*. *trifida* in different localities in the PRA area therefore seems likely.
On the other hand, the intentional introduction of *Ambrosia trifida* seeds is unlikely, and is regulated in France by the Decree of 26 April 2017.

Establishment

The establishment of *A*. *trifida* in the PRA area appears likely in all regions with warm and humid summers, especially in and on the edge of agricultural plots planted with maize, soybeans, sunflower or sorghum. In addition, the species can easily become established alongside water courses. Many of the countries of the European Union could therefore see the establishment of *A. trifida* in meso-hygrophilic environments, from south-west France, north-east Spain and northern Italy through to southern Germany and Poland and a large part of central Europe and the Balkans. The southernmost countries have summers that are too dry while the summers in the countries further north are not hot enough. Inside the PRA area, large populations are presently only observed in the plain of the Po river and in south-west France.

Spread

The natural spread of *A*. *trifida* is slow and limited in distance, except in the case of hydrochory along a water course. However, the risk of long-distance spread by the transport of contaminated soil, crops and especially agricultural equipment used for harvesting infested crops seems very high. The risk of this species spreading from an infested site therefore seems very likely.

Economic importance

From an agricultural point of view, the impact on contaminated plots is very rapid and can result in the total loss of the harvest and additional management costs for the plot. From a social and public health perspective, *A. trifida* contributes to the presence in the atmosphere of allergenic pollen that will only aggravate the issue of pollen-related allergies. This issue affects both the local population and the ability to attract tourism. The probability and magnitude of these impacts within the PRA area will depend on the species' ability to become established in the coming years, according to the different eco-climatic areas identified as favourable to its development.

[3] Introduction, according to the definition in the FAO's Glossary of Phytosanitary Terms, is the entry of a pest resulting in its establishment.

Overall conclusion of the pest risk assessment

Considering the different hazards and risks posed by *A. trifida* for the PRA area, the current low level of the invasion and the difficulties in terms of curative management of this species in the current context, the CES considers that the pest risk is unacceptable. The major points leading to this conclusion are as follows:

- An introduction by the pathway from the area of origin that is difficult to control,
- The broad distribution of favourable eco-climatic areas across the entire PRA area,
- Crop systems favourable to its development, mainly due to the limited effectiveness of chemical and mechanical weed control practices against this species,
- Great difficulties with control in non-agricultural environments,
- The allergic nature of the pollen from this species.

Conclusion of pest risk management

The table below shows the various measures available to combat *A. trifida* according to their effectiveness.

Measure	Effectiveness	Uncertainty
Monitoring the total absence of *A. trifida* seeds in seed lots on entering the PRA area	Very high to avoid any new introduction	Low, but depends on the diversity of enforcement of controls in the PRA area
Widespread use of seed guaranteed free from *A. trifida* seeds in the PRA area	Very high to avoid any new introduction	Low, if farmers comply with the measure
Monitoring the emergence and development of new populations of *A. trifida*	High because of the high detectability of the plant	Medium, because it depends on the establishment of a structured surveillance system
Implementing early eradication measures for newly-reported populations	Very high in agricultural environments, medium in natural or semi-natural environments	Low in agricultural environments because easily applicable, medium in natural and semi-natural environments because it depends on the effectiveness of the decision-making and operational structure
Implementing a containment or eradication plan for already-established populations	Medium in agricultural environments, low in natural and semi-natural environments	Medium in agricultural environments because easily applicable, high in natural and semi-natural environments because it depends on the effectiveness of the decision-making and operational structure

4. AGENCY CONCLUSIONS AND RECOMMENDATIONS

Ambrosia trifida is a weed known to have an impact on agriculture by the colonisation of summer crops and on human health by the allergenic potential and allergenicity of its pollen. There are effective management measures to reduce the health and plant pest risks associated with *A. trifida*. The French Agency for Food, Environmental and Occupational Health & Safety therefore recommends applying all the measures proposed by the CES on "Biological risks for plant health" in order to prevent the introduction, establishment and spread of *A. trifida* in the European Union.

Dr Roger Genet

KEYWORDS

Ambrosia trifida, Ambroisie trifide, Grande herbe à poux, Analyse de risque phytosanitaire
Ambrosia trifida, Giant ragweed, Pest risk assessment

Request for an opinion on conducting a risk analysis relating to the giant ragweed (*Ambrosia trifida* L.) in order to formulate management recommendations[1]

Request No. 2016-SA-0090 *A. trifida*

Collective Expert Appraisal REPORT

CES on "Biological risks for plant health"

"Ragweed" Working Group

July 2017

[1] Cancels and replaces the report of June 2017 (see Annex 3)

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Key words

Ambrosia trifida, Ambroisie trifide, Grande herbe à poux, Analyse de risque phytosanitaire

Ambrosia trifida, Giant ragweed, Pest risk assessment

Presentation of participants

PREAMBLE: The experts, members of the Expert Committees and Working Groups or designated rapporteurs are all appointed in a personal capacity, *intuitu personae*, and do not represent their parent organisation.

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CONTENTS

Acronyms and abbreviations

A. artemisiifolia: *Ambrosia artemisiifolia*

A. psilostachya: *Ambrosia psilostachya*

A. trifida: *Ambrosia trifida*

ANSES: French Agency for Food, Environmental and Occupational Health & Safety

CES: ANSES Expert Committee

EFSA: European Food Safety Authority

EPPO/OEPP: European and Mediterranean Plant Protection Organization

EU: European Union

FAO: Food and Agriculture Organisation of the United Nations

IAS: Invasive Alien Species

PNSE: *Plan national santé environnement* [National Environmental Health Action Plan]

PRA: Pest Risk Analysis

USSR: Union of Soviet Socialist Republics

List of tables

List of figures

1 Background, purpose and procedure for carrying out the expert appraisal

1.1 Background

On 22 October 2014, the European Parliament and the Council published a Regulation on the prevention and management of the introduction and spread of invasive alien species (IAS). This Regulation stipulates, in particular its Article 19, that Member States shall put in place effective management measures for a list of IAS of European Union (EU) concern, which, according to its Article 4, must be adopted by the European Commission in early 2016, by way of implementing acts. This list is to be regularly updated. The inclusion of a species on this list will therefore result in the implementation of preventive and control actions coordinated between the different Member States of the European Union, aimed at reducing the negative impact of these species, primarily on biodiversity and ecosystem services, as well as other possible negative impacts in the case of certain IAS that may affect human health and/or the economy.

For any species to be proposed for the above-mentioned future list, the European Commission must have a risk analysis complying with 14 standards it has specified in the report entitled "Invasive alien species – Framework for the identification of invasive alien species of EU concern. ENV.B.2/ETU/2013/0026", as well as five criteria defined in Article 4 of the Regulation. For some of the species listed in the above-mentioned report, risk analyses are already available. For any that are not listed and that a Member State would like to see proposed as part of the regular updating of the list (see Article 4), a risk analysis must be provided to the European Commission.

Among the plant species of the genus *Ambrosia* present in France, several are invasive alien species with a potential health impact since they release pollen that is highly allergenic for humans. This is particularly the case with common ragweed (*Ambrosia artemisiifolia* L.), giant ragweed (*Ambrosia trifida* L.) and western ragweed (*Ambrosia psilostachya* DC.).

Giant ragweed is also one of the crop weeds that is most difficult to manage in its area of origin, as its size and growing cycle lead to strong competition with the existing vegetation. It was the subject of an ANSES alert sheet in 2013, and observations have confirmed its establishment in the Midi-Pyrénées region within zones that suggest its control is still possible.

Moreover, this species is targeted by several actions of the Third National Environmental Health Action Plan (PNSE 3), in particular Action 11 aiming to better assess exposure to ragweed and monitor its geographical expansion, and Action 12 whose objective is to strengthen and coordinate the management of plant and animal species whose proliferation may be harmful to public health.

1.2 Purpose of the request

In this context and so as to be able to also propose this ragweed in a forthcoming revision of the above-mentioned European list, a risk analysis concerning *A. trifida* was carried out considering the entire European Union as the geographical area. This risk analysis had a risk assessment component including the impact on human health and the effects of climate change in the foreseeable future, and a risk management component, in accordance with the methodology recommended by the European Commission in the framework of the above-mentioned European Regulation.

In order to implement Action 12 of the PNSE 3, the expert appraisal also provided recommendations to strengthen the management of this species in France and improve the coordination of management actions already undertaken in this country.

1.3 Procedure: means implemented

ANSES entrusted examination of this request to the Working Group on "Ragweed" reporting to the CES on "Biological risks for plant health".

The methodological and scientific aspects of this group's work were regularly submitted to the CES. The report produced by the Working Group takes account of the observations and additional information provided by the CES members.

This work was therefore conducted by a group of experts with complementary skills.

The model used for the collective expert appraisal report was the pest risk analysis (PRA) scheme of the European and Mediterranean Plant Protection Organization (EPPO)[2]. The expert appraisal was conducted following the pest risk analysis process, which is subdivided into three interdependent stages: initiation, pest risk assessment (categorisation of the pest, assessment of the likelihood of introduction[3] and spread, assessment of the potential economic consequences), and pest risk management.

The expert appraisal was carried out in accordance with French Standard NF X 50-110 "Quality in Expert Appraisals – General Requirements of Competence for Expert Appraisals (May 2003)".

1.4 Prevention of risks of conflicts of interest

ANSES analyses interests declared by experts before they are appointed and throughout their work in order to prevent risks of conflicts of interest in relation to the points addressed in expert appraisals.

The experts' declarations of interests are made public via the Agency's website (www.anses.fr).

[2] European and Mediterranean Plant Protection Organization (2011) PM 5/3(5) "Guidelines on Pest Risk Analysis. Decision-support scheme for quarantine pests"

[3] Introduction, according to the definition in the FAO's Glossary of Phytosanitary Terms, is the entry of a pest resulting in its establishment.

1.5 A few definitions prior to the PRA

Based on Richardson *et al*., 2000:

- Alien (exotic): In a given area, a species whose presence there is due to intentional or accidental introduction as a result of human activity.
- Indigenous (native): Species that naturally grows in a region without having been imported (Rey and Rey, 2010).
- Casual: Alien plants that may flourish and even reproduce occasionally in an area, and which rely on repeated introductions for their persistence in the environment.
- Naturalized: Alien plants that reproduce consistently in their area of introduction and that manage to sustain populations in the long term without direct intervention by humans.
- Invasive: Subset of naturalised plants that produce reproductive offspring, often in very large numbers and at considerable distances from parent plants, and thus have the potential to spread over a considerable area.

  This definition of invasive species primarily describes the process of spatial colonisation without connotations of impact. At the same time, there are already well-established terms for referring to harmful organisms (indigenous or alien): *pests* for all types of organisms and *weeds* for plants.

- Seed: grains intended to be sown for cultivation.

2 Pest risk analysis

2.1 Stage 1: Initiation

1.01 Give the reasons for performing the PRA.

The PRA was initiated by the revision of a policy: phytosanitary regulations are being revised (Regulation (EU) 2016/2031), and a new regulation concerning invasive alien species (1143/2014) is being put in place. *Ambrosia trifida* is regarded as an invasive alien plant and was the subject of an ANSES alert sheet in 2013. This is based on (COP, 2000), which defines an invasive alien species as a non-indigenous species whose introduction and spread pose an economic and/or environmental threat to ecosystems, habitats or other species, and to human health. When the environment is disrupted, a species may become invasive whether it is of indigenous or non-indigenous origin (Thenot, 2013).
Preventive and control measures should be put in place to prevent invasion phenomena and reduce the impacts on biodiversity and plant health, but also on human health and ecosystem services. The potential economic impacts must also be studied.

1.02 A. Specify the pest or pests of concern and follow the scheme for each individual pest in turn. For intentionally introduced plants, specify the intended habitats.

Scientific name: *Ambrosia trifida* L., according to Linnaeus (1753)

Synonymous scientific names (Source: http://www.theplantlist.org/)**:**
- *Ambrosia aptera* DC.
- *Ambrosia integrifolia* Mulh. ex Willd.
- *Ambrosia trifida* var*. aptera* (DC.) Kuntze
- *Ambrosia trifida* var*. heterophylla* Kuntze
- *Ambrosia trifida* var*. integrifolia* (Mulh ex. Willd) Torr. & A.Gray
- *Ambrosia trifida* f*. integrifolia* (Mulh ex. Willd) Fernald
- *Ambrosia trifida* var*. polyploidea* J.Rousseau
- *Ambrosia trifida* var*. texana* Scheele
- *Ambrosia trifida* subsp*. trifida*
- *Ambrosia trifida* var*. trifida*
- *Ambrosia trifida* f*. trifida*

Common names:
- France: Ambroisie trifide
- United Kingdom: Great ragweed; Blood ragweed; Buffalo-weed; Crownweed; Horseweed
- Spain: Artemisa grande
- Germany: Dreilappige Ambrosie; Dreispaltige Ambrosie; Dreilappentraubenkraut; Dreilappiges Traubenkraut
- Canada: Giant ragweed; Kinghead; Grande herbe à poux; Ambroisie trifide
- China: san lie ye tun cao
- United States: Giant ragweed; Bitterweed; Buffalo weed; Crown-weed; Horse-cane; Horse-weed; Kinghead; Tall ragweed

- Estonia: Kolmehõlmane ambroosia
- Finland: Sormituoksukki
- Japan: Kuwamodoki; Oobutakusa
- Latvia: Trisdaivu ambrozija
- Lithuania: Triskiaute ambrozija
- Norway: Hesteambrosia
- The Netherlands: Driedeelige Ambrosia
- Poland: Ambrozja trójdzielna
- Czech Republic: Ambrozie trojklaná
- Slovakia: Ambrózia trojzárezová
- Slovenia: Trikrpata žvrklja
- Sweden: Hästambrosia; Tall Ambrosia

Taxonomy: Domain: Eukaryota / Kingdom: *Plantae* / Division: *Spermatophyta* / Sub-Division: *Angiospermae* / Class: *Dicotyledonae* / Order: *Asterales* / Family: *Asteraceae* / Genus: *Ambrosia* / Species*: Ambrosia trifida*

1.02 b. Specify the pathway of concern and identify the individual pests likely to be associated with the pathway and follow the scheme for each individual pest in term.

Not applicable.

1.02 c. If other trigger for the PRA, specify.

Not applicable.

1.03 Clearly define the PRA area.

The European Union.

Earlier analysis
The pest, or a very similar pest, may have been subjected to the PRA process before, nationally or internationally. This may partly or entirely replace the need for a new PRA. A PRA may also have been prepared for the same pathway.

1.04 Does a relevant earlier PRA exist?

No
A PRA was conducted by Poland on *Ambrosia* spp.: "Pest Risk Analysis and Pest Risk Assessment for the territory of the Republic of Poland (as PRA area) on *Ambrosia* spp." by Karnkowski (2001). *Ambrosia* spp. *(Ambrosia artemisiifolia, Ambrosia trifida and Ambrosia psilostachya*) have been categorised as quarantine organisms.
There is another PRA for the same species with the PRA area being Lithuania: "Pest risk analysis and pest risk assessment for the territory of Lithuania (as PRA area) on *Ambrosia* spp. *(Ambrosia artemisiifolia, Ambrosia trifida and Ambrosia psilostachya)*" (2003). Species of the genus *Ambrosia* have been described as quarantine organisms that require the use of phytosanitary measures.

These two PRAs suggested the same management measures to control species of the genus *Ambrosia*:

- Implementing preventive measures in cultivated fields, aiming to prevent the production of *Ambrosia* spp. seeds. These measures can be mechanical, chemical or agronomic. These

PRAs also advocate the set-aside of infested fields for several years after the application of preventive measures.

- If the crops are heavily infested by species of the genus *Ambrosia* and the previous measures are insufficient, other measures can be implemented. A visual inspection of crops (grain, seed and fodder) intended for export must be carried out after harvest and before export. Contaminated seed lots and grain should be cleaned or crushed in such a way as to destroy all the seeds from species of the genus *Ambrosia*.
- Because species of the genus *Ambrosia* can be spread by means of transport (unsealed containers that disperse the seeds of species of the genus *Ambrosia* onto roads, railways, etc.), it is important to place products infested by or suspected of being infested by ragweed into sealed containers.
- Products from infested areas must only be exported to areas already infested by ragweed, to avoid the expansion of these species to other geographical areas.

These management measures may be ineffective if the ragweed invasion is too great. It is also difficult to eliminate species of the genus *Ambrosia* in crops because the seeds and/or the creeping roots with suckers present in the soil are persistent, which implies management over the medium and long term.

1.05 Is the earlier PRA still entirely valid or only partly valid (out of date, applied in different circumstances, for a similar but distinct pest, for another area with similar conditions)?

These two earlier PRAs (Karnkowski, 2001 and Anonymous, 2003) are only partly valid.
These PRAs only apply respectively to Poland and Lithuania, they should therefore be updated and supplemented taking into account the new literature data available and the extension of the PRA area to the entire European Union.

Moreover, EFSA assessed the content of these two PRAs in 2007:

- Opinion of the Scientific Panel on Plant Health on a request from the Commission on the pest risk assessment made by Lithuania on *Ambrosia* spp. *The EFSA Journal* (2007) 527, 1-33.
- Opinion of the Scientific Panel on Plant Health on a request from the Commission on the pest risk assessment made by Poland on *Ambrosia* spp. *The EFSA Journal* (2007) 528, 1-32.

These two assessments on the PRAs carried out by Lithuania and Poland raised the same remarks:

- The PRAs were carried out on the genus *Ambrosia*, which is too general a level considering that only three ragweed species pose risks (*Ambrosia trifida, Ambrosia psilostachya* and *Ambrosia artemisiifolia*). Given that these do not have the same ecology and biology, it would have been more advisable to conduct targeted PRAs for each species,
- Details are lacking about the distribution of each ragweed in the countries bordering Lithuania and Poland, as well as on the habitats occupied by these ragweed,
- A revision is needed regarding the pathways of introduction (including by international trade) and dissemination,
- The lack of data regarding the impact of each ragweed on the economy, on other plants and on human health makes it impossible to conclude as to the risks of these ragweed in the PRA area.

It would have been interesting to highlight the geographical areas of the EU likely to be infested by ragweed in the future.

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.

Habitats occupied in the area of origin:

In its area of origin, *A. trifida* primarily grows in New England, on the shores of lakes and the banks of the Ohio and Mississippi rivers, as well as in southern Canada (Bassett and Crompton, 1982).

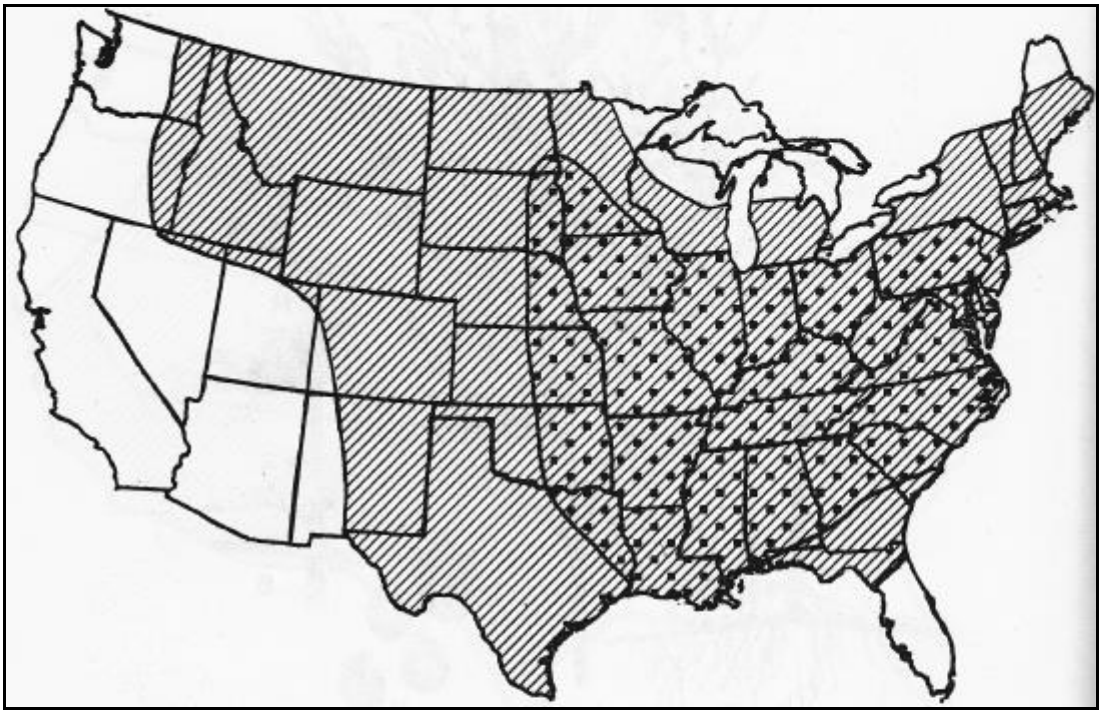

Figure 1 – Distribution of *A. trifida* in the United States – areas with additional marks indicate those where *A. trifida* is considered of economic importance (USDA, 1970).

Originally, *A. trifida* was mainly distributed in naturally disturbed areas (the banks of water courses).
However, in recent decades it has adapted to agricultural conditions and is now able to thrive in cultivated fields (Bassett and Crompton, 1982). Today it is regarded as a major weed (Ganie *et al*., 2017).
It has also become established in gardens, ditches, brownfield sites and disturbed habitats (roadsides and near fences). It is a meso-hygrophilic species, preferring wet meadows to drier areas (Bassett and Crompton, 1982; Uva *et al*., 1997; Harrison *et al*., 2001).
In addition, *A. trifida* seems to prefer establishment at latitudes between 45° and 30° North, because of fairly strict photoperiodic constraints for flowering, which may maximise its reproduction (Allard, 1943).

Habitats occupied in the area of introduction:

In central and eastern Europe, *A. trifida* mainly occupies ruderal habitats including railway tracks. It has also colonised the banks of the Elbe River in Germany (Jehlik and Hejny, 1974) and cultivated fields (Rydlo *et al.,* 2011). According to Stoyanov (2014), *A. trifida* may be established around *Robinia pseudoacacia* L. bushes close to the railway at the exit of the town of Dalgopol (Bulgaria). It is reported in the whole of northern Italy (Piedmont, Lombardy, Veneto, Tuscany, etc.; http://luirig.altervista.org/flora/taxa/index2.php?scientific-name=ambrosia+trifida), especially in the plain of the Po (Atzori *et al.*, 2009; Ardenghi, 2010).

In Japan and Korea, it grows in semi-natural areas (Miyawaki, 2004; Lee *et al.,* 2010). As in Europe and its area of origin, it is found along rivers and roads, but also in cultivated fields (Lee *et al.,* 2010).

In France at the beginning of the 20th century, *A. trifida* was mainly reported in environments exposed to anthropogenic activities (ports, ruins, waste land, military camps, etc.). It is now primarily observed in cultivated land in the *départements* of the Haute-Garonne and the Ariège (Chauvel *et al*., 2015). It was recently reported in gravel pits (personal communication, Midi-Pyrénées Botanical Conservatory) and on the banks of water courses (Belhacène, 2007), although these reports have not been recently confirmed and population monitoring has not been carried out.

1.07 Specify the pest distribution for a pest-initiated PRA, or the distribution of the pests identified in 1.02b for a pathway-initiated PRA.

Ambrosia trifida is an invasive alien plant originating in the east of North America. The worldwide distribution of *A. trifida* is shown in Table 1 and the map below (Figure 2).

Table 1 – Distribution area of *Ambrosia trifida*

Country	Distribution	Origin	Date of introduction	Invasive species	References
ASIA					
China	Limited distribution	Non-native	1935	Invasive	Yan *et al*., 2001; EPPO, 2014; Qin *et al*., 2014
• Beijing	Present	Non-native	1987		EPPO, 2014; Ma and Liu, 2002
• Hebei	Present	Non-native	1987	Invasive	EPPO, 2014; Ma and Liu, 2002
• Heilongjiang	Present	Non-native			EPPO, 2014
• Hubei	Present	Non-native			EPPO, 2014
• Hunan	Present	Non-native			EPPO, 2014
• Jiangxi	Present	Non-native			EPPO, 2014
• Jilin	Present	Non-native			EPPO, 2014
• Shandong	Present	Non-native			EPPO, 2014
• Zhejiang	Present	Non-native			EPPO, 2014
• Liaoning	Present	Non-native			EPPO, 2014
Georgia	Limited distribution				EPPO, 2014
Israel	Eradicated				EPPO, 2014
Japan	Present	Non-native			Yamazaki *et al*., 2000; Nishida *et al*., 2009; EPPO, 2014
South Korea	Widespread	Non-native	1950s	Invasive	EPPO, 2014; Shim *et al*., 1998; Kil *et al*., 2014
Mongolia	Present	Non-native			EPPO, 2012
NORTH-AMERICAN CONTINENT					
Canada	Present	Native		Invasive	Mulligan, 2000
• Alberta	Present	Native		Non-invasive	Mulligan, 2000; EPPO, 2014
• British Colombia	Present	Native		Non invasive	Mulligan, 2000
• Manitoba	Present	Native		Invasive	Mulligan, 2000; EPPO, 2014

• New-Brunswick	Present	Native		Non invasive	Mulligan, 2000; EPPO, 2014
• Northwest Territories	Present	Native		Non invasive	Mulligan, 2000
• Nova Scotia	Present	Native		Non invasive	Mulligan, 2000; EPPO, 2014
• Ontario	Present	Native		Invasive	Mulligan, 2000; EPPO, 2014
• Prince Edward Island	Present	Native			USDA-ARS, 2003; EPPO, 2014
• Quebec	Present	Native		Invasive	Mulligan, 2000; EPPO, 2014
• Saskatchewan	Present	Native		Invasive	Mulligan, 2000; EPPO, 2014
Mexico	Limited distribution	Native			USDA-ARS, 2003; EPPO, 2014
United States	Present	Native		Invasive	Uva *et al.*, 1997; USDA-NRCS, 2012
• Alabama	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• Arizona	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• Arkansas	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• California	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• Colorado	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• Connecticut	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• Delaware	Widespread	Native		Invasive	USDA-NRCS, 2012; EPPO, 2014
• Florida	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• Georgia	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• Idaho	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• Illinois	Widespread	Native		Invasive	USDA-NRCS, 2012; EPPO, 2014
• Indiana	Widespread	Native		Invasive	USDA-NRCS, 2012; EPPO, 2014
• Iowa	Present	Native		Invasive	USDA-NRCS, 2012; EPPO, 2014
• Kansas	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• Kentucky	Widespread	Native		Invasive	USDA-NRCS, 2012; EPPO, 2014
• Louisiana	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• Maine	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014

• Maryland	Widespread	Native		Invasive	USDA-NRCS, 2012; EPPO, 2014
• Massachusetts	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• Michigan	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• Minnesota	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• Mississippi	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• Missouri	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• Montana	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• Nebraska	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• New Hampshire	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• New Jersey	Present	Native		Invasive	USDA-NRCS, 2012; EPPO, 2014
• New Mexico	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• New York	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• North Carolina	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• North Dakota	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• Ohio	Widespread	Native		Invasive	USDA-NRCS, 2012; EPPO, 2014
• Oklahoma	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• Oregon	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• Pennsylvania	Present	Native		Invasive	USDA-NRCS, 2012; EPPO, 2014
• Rhode Island	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• South Carolina	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• South Dakota	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• Tennessee	Widespread	Native		Invasive	USDA-NRCS, 2012; EPPO, 2014
• Texas	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• Utah	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• Vermont	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• Virginia	Present	Native		Invasive	USDA-NRCS, 2012; EPPO, 2014

• Washington	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• West Virginia	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
• Wisconsin	Present	Native		Invasive	USDA-NRCS, 2012; EPPO, 2014
• Wyoming	Present	Native		Non invasive	USDA-NRCS, 2012; EPPO, 2014
SOUTH-AMERICAN CONTINENT					
Brazil	Present	Non-native			USDA-NRCS, 2012
EUROPE					
Albania	Present	Non-native		To be specified	Royal Botanic Garden Edinburgh, 2003
Germany	Present	Non-native	1877	Naturalised	Royal Botanic Garden Edinburgh, 2003; EPPO, 2014; B für Naturschutz, 2011
Austria	Transient: Management measure	Non-native	1948	Casual	USDA-NRCS, 2012; EPPO, 2014
Belgium	Transient: Management measure	Non-native	1894	Casual	USDA-NRCS, 2012; EPPO, 2014
Belarus	Transient: Management measure	Non-native		Casual	USDA-NRCS, 2012; EPPO, 2014
Bulgaria	Present	Non-native	1993	Naturalized	Royal Botanic Garden Edinburgh, 2003; Stoyanov et al., 2014
Denmark	Transient: Management measure	Non-native		Casual	EPPO, 2014
Spain	Present	Non-native		Casual	EPPO, 2014
Estonia	Transient: Management measure	Non-native		Casual	USDA-NRCS, 2012; EPPO, 2014
France	Present	Non-native	1901 (Alsace)	Naturalized	Royal Botanic Garden Edinburgh, 2003; EPPO, 2014
Ireland	Rare	Non-native		Casual	EPPO, 2014
Italy	Present	Non-native		Naturalised	Royal Botanic Garden Edinburgh, 2003; EPPO, 2014; Celesti-Grapow et

					al., 2009; Follak et al. 2013
Latvia	Transient: Management measure	Non-native		Casual	USDA-NRCS, 2012; EPPO, 2014
Lithuania	Transient: Management measure	Non-native	1947	Casual	EPPO, 2014; Gudzinskas, 1993
Luxembourg		Non-native	1950	Casual	Beck et al., 1951
Moldova		Non-native		Casual	USDA-NRCS, 2012; EPPO, 2014
Norway	Transient: Management measure	Non-native		Casual	EPPO, 2014
The Netherlands	Present	Non-native		Casual	EPPO, 2014
Poland	Transient: Management measure	Non-native		Casual	EPPO, 2014; Karnkowski, 2001
Portugal	Present	Non-native		Casual	Royal Botanic Garden Edinburgh, 2003
Czech Republic	Transient: Management measure	Non-native	1960	Naturalized	USDA-NRCS, 2012; EPPO, 2014; Royal Botanic Garden Edinburgh, 2003; Follak et al. 2013
Romania	Present	Non-native	~1970	To be specified	EPPO, 2014
United Kingdom	Transient: Management measure	Non-native	1897	Casual	EPPO, 2014; Allard, 1943
Russia	Limited distribution	Non-native		Naturalized	Biodiversity, 2003; EPPO, 2014
• Central Russia	Limited distribution	Non-native			EPPO, 2014
• Southern Russia	Widespread	Non-native			EPPO, 2014
Serbia	Present	Non-native		Naturalized	Pajevic et al., 2010; USDA-NRCS, 2012; EPPO, 2014; Follak et al. 2013

Slovakia	Transient: Management measure, eradication under way	Non-native	1980	Casual	EPPO, 2014; Royal Botanic Garden Edinburgh, 2003
Slovenia	Transient: Management measure	Non-native	1980	Casual	USDA-NRCS, 2012; EPPO, 2014
Switzerland	Present	Non-native		Casual	USDA-NRCS, 2012; EPPO, 2014
Ukraine	Transient: Management measure	Non-native		Casual	USDA-NRCS, 2012; EPPO, 2014

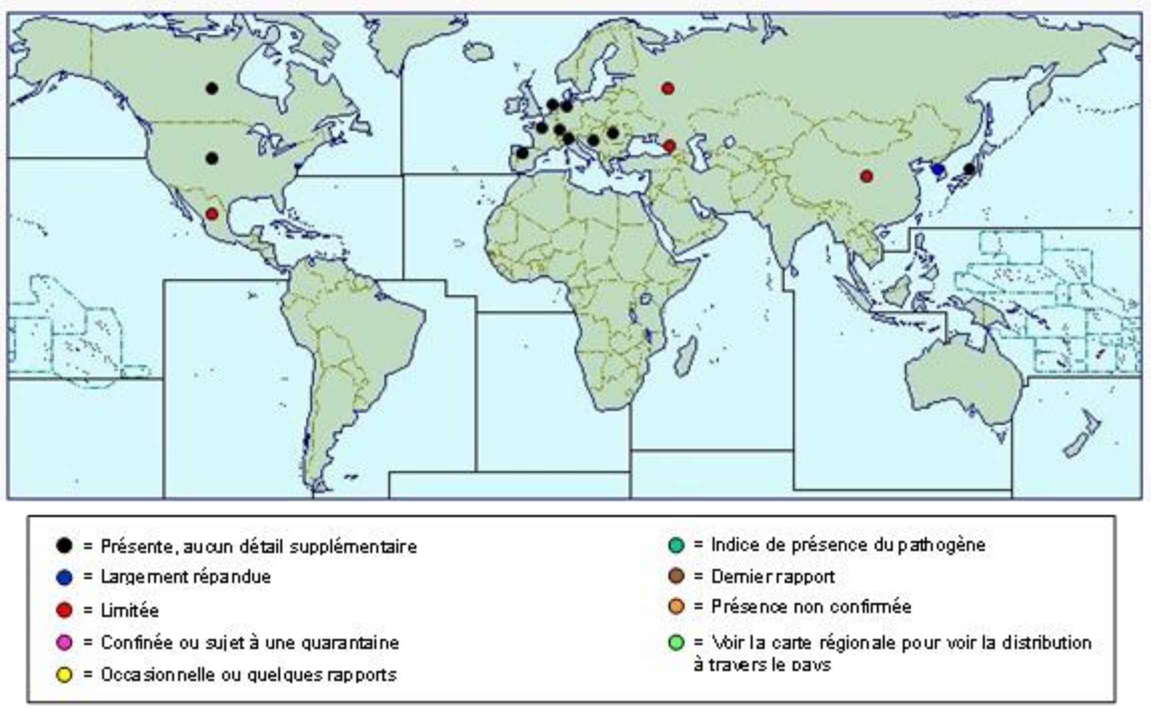

Figure 2 – Global Distribution of *A. trifida* (Source: www.cabi.org/cpc, 1 December 2015).

2.2 Stage 2: Pest risk assessment

2.2.1 Section A: Pest categorisation

2.2.1.1 Identify the pest (or potential pest)

1.08 Is the organism clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank?

Yes, *A. trifida* is a separate entity and can be precisely distinguished from entities of the same order.

Taxonomy: Domain: Eukaryota / Kingdom: *Plantae* / Division: *Spermatophyta* / Sub-Division: *Angiospermae* / Class: *Dicotyledonae* / Order: *Asterales* / Family: *Asteraceae* / Genus: *Ambrosia* / Species*: A. trifida*

A. trifida is an annual plant that can measure from 1 to 3 m in height, or even 3 to 5 m in its area of origin (Karnkowski, 2001). It has large leaves (4-15 cm long). They are oppositely arranged, simple, and palmately lobed, generally with three lobes (they may also have five lobes or be unlobed). Alone, the upper leaves can be alternate. They are borne on a long petiole (3-12 cm).
Male and female flowers are separated on the same individual (monoecious plant – Jauzein, 1995). The inflorescences are long terminal clusters (30 cm) consisting of florets of male flowers. The female flowers are grouped into florets at the base of the male clusters and sometimes in the axils of the upper leaves.
The fruit is a cup-shaped achene, tipped with a long central beak surrounded by a crown of 5 shorter tips. It measures from 0.5 to 1.2 cm long and from 0.3 to 0.5 cm wide. *A. trifida* is characterised by enormous variability in the size and shape of its seeds, which may correspond to an ability to germinate in a variety of conditions (Harrison *et al*., 2007).
Figure 3 shows a botanical specimen of *A. trifida*.
The seedlings are able to develop very quickly (Abul-Fatih and Bazzaz, 1979). *A. trifida* has a high photosynthetic ability compared to most annual species (Barnett and Steckel, 2013). In its area of origin, it flowers from mid-June to the end of August, or even early September (Bassett and Crompton, 1982). In France, the flowering dates observed in south-west France are similar to that in its area of origin (personal communication B. Chauvel).

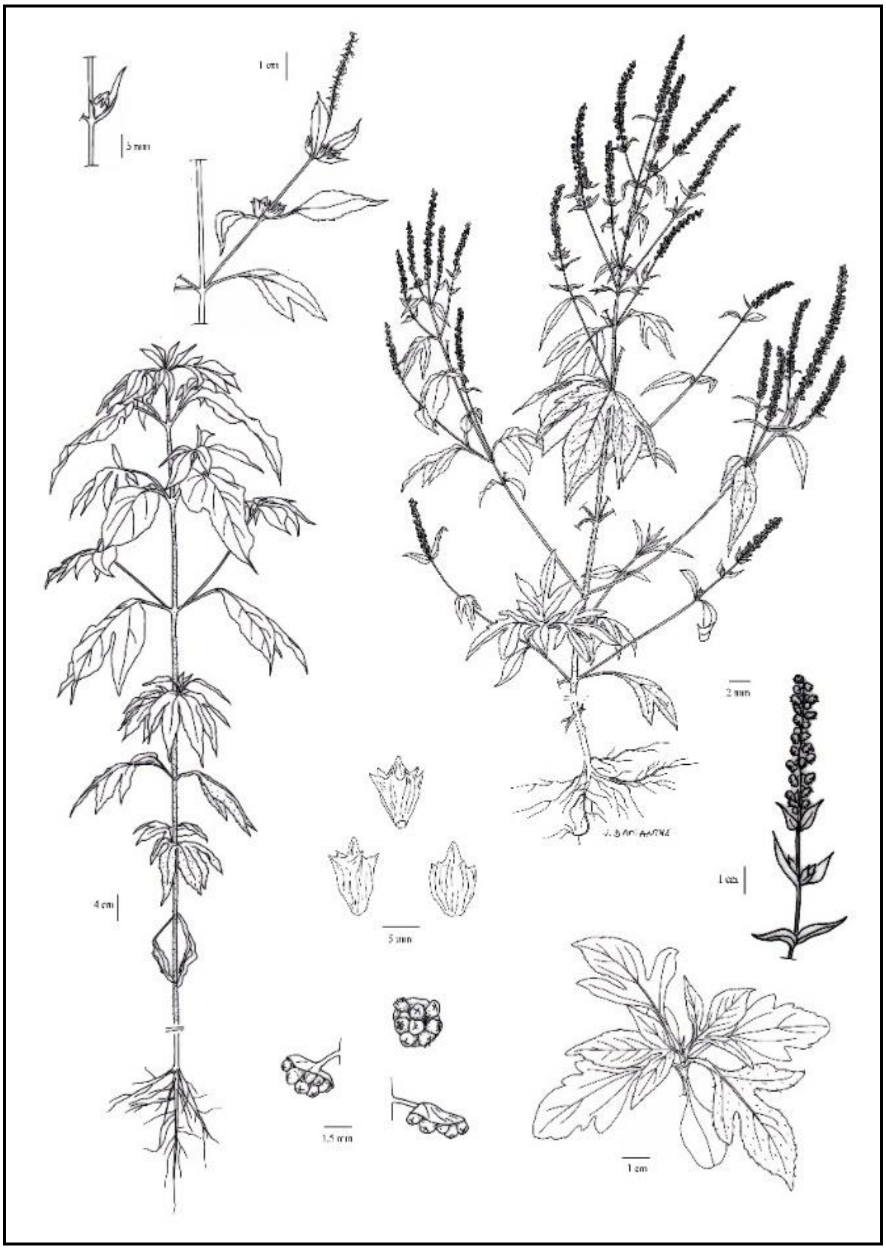

Figure 3 – Drawing of *Ambrosia trifida* Ragweed Observatory (http://ambroisie.info/pages/doc.htm). Drawings by Vanessa Damianthe.

Germination of *A. trifida* is most effective when temperatures are between 20 and 30°C (Karnkowski, 2001). In the conditions in south-west France, germination and emergence can begin in mid-May and continue later into the summer until the month of September, especially in irrigated fields (personal communication B. Chauvel). The long emergence period responsible for the management problems has been confirmed by investigations carried out in the United States (Figure 4).

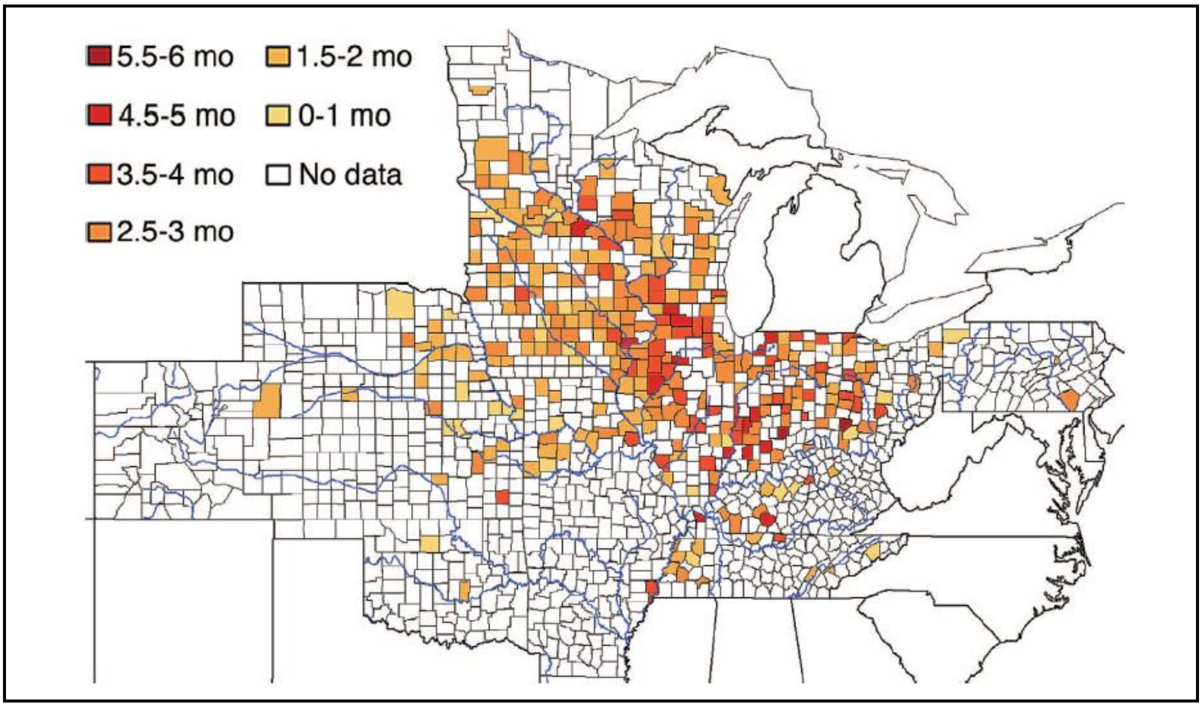

Figure 4 – Duration of the emergence period of *A. trifida* in the United States (Regnier *et al*., 2016)

Ambrosia trifida is a diploid species (2n = 24; Payne, 1964) that essentially reproduces through cross-pollination. Within the genus *Ambrosia, A. trifida* can hybridise with *A. artemisiifolia* (Vincent *et al*., 1987; Vincent *et al*., 1988) to give a new taxon, *A.* x *helenae* Rouleau 1944, but this taxon is described as sterile (Vincent *et al*., 1988). Such hybrids were observed in the 1940s in France in the Bordeaux botanical garden (Chauvel *et al*., 2015).

Criteria distinguishing *A. trifida* from other species of the genus *Ambrosia*:

The distinctive features of *A. trifida*, *A. artemisiifolia* and *A. psilostachya* are summarised in Table 2. *Ambrosia trifida* differs from other annual ragweed by its size (1 to 5 m) and the shape of its leaves, generally three lobes (sometimes only one and up to five), as well as by the size of its seeds (3 to 6 mm and weighing around 50 mg; http://ambroisie.info/docs/Lettre_observatoire_016.pdf), which are much larger than those of other species of the same genus.

The pollen grains of *A. trifida* and *A. artemisiifolia* can be distinguished by the number of spines on the outer wall. *A. trifida* has 60 to 65 spines on half of the grain, while *A. artemisiifolia* has 70 to 75 (Bassett and Crompton, 1982; Qin *et al*., 2014).

Table 2 – Summary of distinctive features of *Ambrosia trifida*, *Ambrosia artemisiifolia* and *Ambrosia psilostachya* (Source: Ragweed Observatory No. 16, 2013)

		Ambrosia psilostachya	*Ambrosia artemisiifolia*	*Ambrosia trifida*
Life cycle		Perennial	Annual	Annual
Leaves	Position	Oppositely arranged then rapidly alternate	Oppositely arranged then alternate	Oppositely arranged except under inflorescence
	Division	+ (++)	++	-
Seeds	Size in millimetres	2 – 3	2 – 3	3 – 6 (7+)
	Crown of spines and beak	Beak < 1 mm Spines < 0.3 mm	1 mm < Beak < 2 mm Spines > 0.3 mm	2 mm < Beak < 4 mm
Underground system		Roots and suckers	Tap root	Tap root
Odour		Fragrant	Very rarely fragrant	Fragrant
Size		0.1-0.9 (1.2) m	0.1-1.2 (2) m	Large 1.5-3 (5) m)

1.09 Even if the causal agent of particular symptoms has not yet been fully identified, has it been shown to produce consistent symptoms and to be transmissible?

Not applicable.

2.2.1.2 Determining whether the organism is a pest

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

Yes,
Ambrosia trifida is known as a pest of plants in its area of current distribution (Royer and Dickinson, 1999).

Although *A. trifida* is observed at densities lower than *A. artemisiifolia*, it is regarded as presenting a higher risk for plants and humans (Qin *et al.*, 2014).
In the United States, *A. trifida* is regarded as one of the most harmful weeds to summer crops (https://plants.usda.gov/core/profile?symbol=amtr). It has the status of "Noxious Weed" in 46 states of the United States (USDA, 2017). In addition, populations resistant to glyphosate have been observed in the United States and in Canada in more than ten states (Heap, 2017).
In China, *A. trifida* is known to be one of the most harmful weeds. Its significance as a crop pest is related to its rapid development and its large size, as well as to its allelopathic properties (Baysinger and Sims, 1991; Kil *et al.*, 2014; Kong *et al.*, 2007).

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

Not applicable.

2.2.1.3 Presence or absence in the PRA area and regulatory status (pest status)

1.12 Does the pest occur in the PRA area?

Yes,
Ambrosia trifida is present in the PRA area. It was introduced into Europe during the 19th century but it expanded its range after the Second World War (Follak *et al*., 2013, Chauvel *et al.,* 2015) (Table 3, Figure 5). According to Poscher (1997), *A. trifida* has been introduced in Europe with imports of animal feed and seed lots of clover. Other pathways of entry have been described, such as imports of grain (Part 2.2.2.2) for the agri-food industry (Verloove, 2006).

Germany: Mentioned for the first time in 1877 in Hamburg, *A. trifida* may have been introduced with foreign wheat seed (Follak *et al*., 2013).

Austria: *A. trifida* was found for the first time in 1948 in Graz, in south-east Austria.

Belgium: *A. trifida* was mentioned for the first time in 1894 in Heverlee by Suttor (Lawalrée, 1947). It may have been introduced by imports of contaminated wool in the valley of the Vesdre. The species seems to be more frequently introduced via imports of grain for the agri-food industry (Verloove, 2006).

France: *A. trifida* has been mentioned in French botanical gardens since 1765 (Paris). The first observations of *A. trifida* were made in Alsace between 1901 and 1904 (under German occupation and related to imports into Germany carried out at this time). Other observations were made during the First World War concerning populations introduced with forage from the United States. Naturalisation of the species in France seems to be recent and unrelated to the first introductions at the beginning of the 20th century; it may be linked to more recent and more southerly introductions, probably with seed lots of soybeans (Chauvel *et al*., 2015).

Ireland: *A. trifida* is rare or casual in Ireland. No recent observations have been made. It would seem that the species was introduced by imports of contaminated seed (EPPO, 2014).

Italy: *A. trifida* is mainly found in northern Italy (Atzori *et al*., 2009; Ardenghi, 2010).

Lithuania: The first observation of the species was in 1947 in Vilnius. New observations of *A. trifida* were then made 40 years later (1987). Its introduction may be linked to imports of North American seed (Gudzinskas, 1993).

Luxembourg: The species was observed at Neudorf in 1950 on ruins, in conjunction with *A. artemisiifolia* (Beck *et al*., 1951).

Netherlands: The species is found at ports (grain imports), and in cereal processing companies (EPPO, 2014).

Poland: During the period from 1900 to 1997, 20 outbreaks of *A. trifida* were identified in Poland (Karnkowski, 2001).

Czech Republic: The first *A. trifida* plant was reported in 1960 in Brno. Since then, the species has spread to different points of the Czech Republic (Follak *et al*., 2013).

Romania: *A. trifida* has been mentioned in south-west Romania since 1970-1980 (Culita and Oprea, 2011).

United Kingdom: *A. trifida* is mentioned as having been cultivated in 1629 in England. This quote is nevertheless surprising because of the date of introduction and cultivation of this species (Murray, 1808). *A. trifida* was then found in the wild in 1897. Since 1970, its abundance has decreased thanks to improvements in control techniques and the ceasing of bulk cargo imports (Online Atlas of the British and Irish Flora).

Slovakia: The introduction of *A. trifida* is due to imports of North American seed via the USSR (Jehlik and Dostalek, 2008). It was found for the first time in 1980 (EPPO, 2014).

Slovenia: *A. trifida* was observed for the first time in 1980 (EPPO, 2014).

Table 3 – Distribution of *Ambrosia trifida* in the PRA area (EU)

Country	Distribution	Origin	Date of introduction	Invasive species	References
European Union					
Germany	Present	Alien	1877	Naturalized	Royal Botanic Garden Edinburgh, 2003; EPPO, 2014; B für Naturschutz, 2011
Austria	Transient: Management measure	Alien	1948	Casual	USDA-NRCS, 2012; EPPO, 2014
Belgium	Transient: Management measure	Alien	1894	Casual	USDA-NRCS, 2012; EPPO, 2014
Bulgaria	Present	Alien	1993	Naturalized	Royal Botanic Garden Edinburgh, 2003; Stoyanov et al., 2014
Denmark	Transient: Management measure	Alien		Casual	EPPO, 2014
Spain	Present	Alien		Casual	EPPO, 2014
Estonia	Transient: Management measure	Alien		Casual	USDA-NRCS, 2012; EPPO, 2014
France	Present	Alien	1901	Naturalized	Royal Botanic Garden Edinburgh, 2003; EPPO, 2014
Ireland	Rare	Alien		Casual	EPPO, 2014
Italy	Present	Alien		Naturalized	Royal Botanic Garden Edinburgh, 2003; EPPO, 2014
Latvia	Transient: Management measure	Alien		Casual	USDA-NRCS, 2012; EPPO, 2014
Lithuania	Transient: Management measure	Alien	1947	Casual	EPPO, 2014; Gudzinskas, 1993
Luxembourg		Alien	1950	Casual	Beck et al., 1951

The Netherlands	Present	Alien		Casual	EPPO, 2014
Poland	Transient: Management measure	Alien		Casual	EPPO, 2014; Karnkowski, 2001
Portugal	Present	Alien		Casual	Royal Botanic Garden Edinburgh, 2003
Czech Republic	Transient: Management measure	Alien	1960	Naturalized	USDA-NRCS, 2012; EPPO, 2014; Royal Botanic Garden Edinburgh, 2003
Romania	Present	Alien	~1970	To be specified	EPPO, 2014
United Kingdom	Transient: Management measure	Alien	1897	Casual	EPPO, 2014; Allard, 1943
Slovakia	Transient: Management measure	Alien	1980	Casual	EPPO, 2014; Royal Botanic Garden Edinburgh, 2003
Slovenia	Transient: Management measure	Alien	1980	Casual	USDA-NRCS, 2012; EPPO, 2014

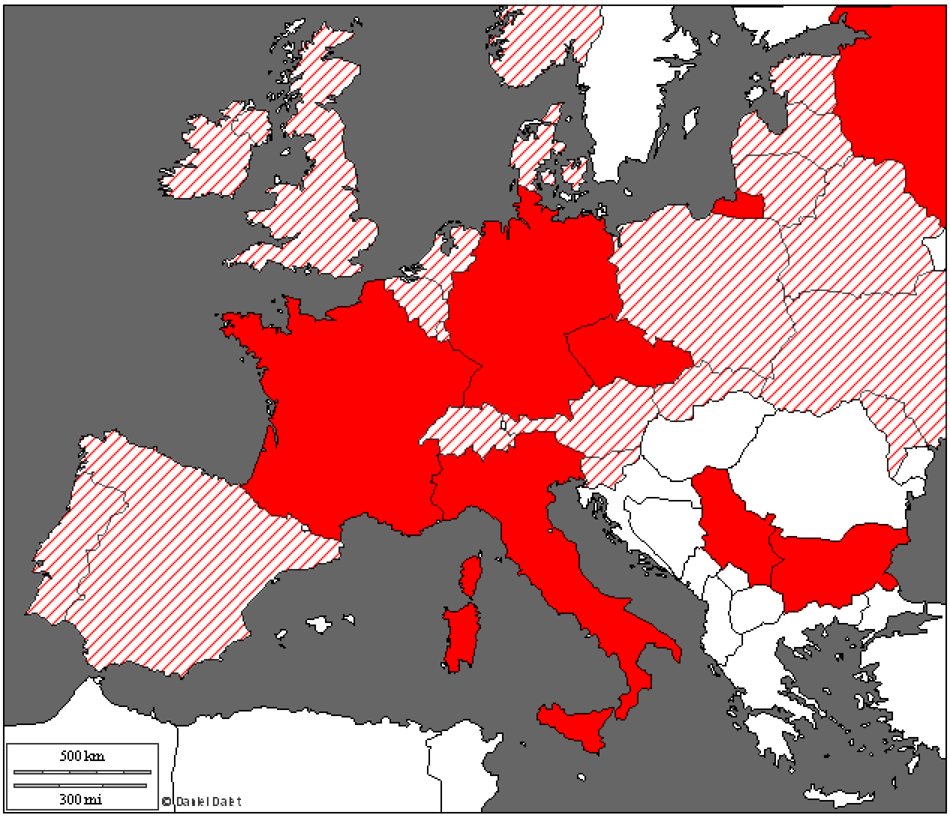

Figure 5 – Distribution of *A. trifida* at the scale of the European Union (based on Table 1)

Countries where the species is naturalized are shown in solid red and countries where the species is casual are hatched.

1.13 Is the pest widely distributed in the PRA area?

Ambrosia trifida is present in several countries of the European Union, but until now often in the form of small populations of varying stability (Follack *et al*., 2013). Of the 324 observations of *A. trifida* in Central Europe, only 27% were considered as naturalized. In Western Europe, there are well-established populations with high densities, for example in south-west France (Chauvel *et al*., 2015).

2.2.1.4 Potential for establishment and spread in the PRA area

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
Ambrosia trifida can find suitable habitats for its establishment in the PRA area. It occupies different environments: agricultural land (Rydlo *et al*., 2011), the banks of major water courses such as the Rhine and the Elbe, the banks of streams or canals (Jehlik and Hejny, 1974), road networks, and other disturbed environments (brownfield sites), as well as green urban areas (gardens) (Follak *et al.,* 2013) (Corine Land Cover nomenclature).

According to the EUNIS habitat classification, *A. trifida* can be found in four major habitat categories (C: Inland surface waters; E: Grasslands and lands dominated by forbs, mosses or lichens; I: Regularly or recently cultivated agricultural, horticultural and domestic habitats, and X: Habitat complexes). *A. trifida* seems to preferentially become established in crops (I1) and ruderal environments (E). It is also found in the littoral zone of inland surface waterbodies (C3), bare tilled, fallow or recently abandoned arable land (I1-5), road networks (J4-2), rail networks (J4-3) and domestic and non-domestic gardens (X).

1.15 If a vector is the only means by which the pest can spread, is a vector present in the PRA area?

Not applicable.

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 PRA area includes climate zones similar to those where *A. trifida* is already established. Certain species of the genus *Ambrosia* (*A. artemisiifolia, A. psilostachya, A. trifida*) grow in temperate, continental warm or dry climates (Oberdorfer, 1994). The average temperature in the month of April is very important for these species because this is the month during which they begin to develop (Karnkowski, 2001).

A. trifida grows preferentially in relatively damp environments and on river banks. It has difficulty becoming established in urban ruderal environments in which the water balance is insufficient (Chauvel *et al*., 2015). Optimal germination occurs at temperatures between 20 and 30°C (Bassett and Crompton, 1982).
In the EU, *A. trifida* is mainly found in countries with a humid continental climate with warm or warm temperate summers (Table 4 and Figure 6). But it can also become established in a wide range of climates, provided that the environment has a water balance conducive to its development.

Certain countries of the EU, such as Luxembourg, where *A. trifida* is not yet naturalised, which have a favourable climate and which are located at latitudes between 30 and 45 degrees north, could soon be invaded. A change in climate could promote development of this species and increase the density of its populations or the size of its individuals, but would probably not allow *A. trifida* to extend its range to other more northerly countries of the EU such as Finland and Sweden, due to photoperiod constraints (Allard, 1943).

Table 4 – Summary of climates observed in the countries of the EU where *A. trifida* is established (Source: Köppen Geiger)

Country	Code	Climate
Germany	Cfb	Warm and humid temperate with warm summers.
	Dfb	Humid continental with warm summers.
Austria	Dfb	Humid continental with warm summers.
Belgium	Cfb	Warm and humid temperate with warm summers.
Bulgaria	Dfb	Humid continental with warm summers.
	Dfc	Humid continental with cold summers.
Denmark	Cfb	Warm and humid temperate with warm summers.
	Dfb	Humid continental with warm summers.
Spain	Cfb	Warm and humid temperate with warm summers.
	Csa	Warm temperate with very warm dry summers.
	BSk	Semi-arid steppe, with cold temperatures.
Estonia	Dfb	Humid continental with warm summers.
France	Cfb	Warm and humid temperate with warm summers.
	Csa	Warm temperate with very warm dry summers.
Hungary	Dfb	Humid continental with warm summers.
Ireland	Cfb	Warm and humid temperate with warm summers.
Italy	Cfa	Humid temperate with very warm summers.
	Csa	Warm temperate with very warm dry summers.
Latvia	Dfb	Humid continental with warm summers.
Lithuania	Dfb	Humid continental with warm summers.
The Netherlands	Cfb	Warm and humid temperate with warm summers.
Poland	Dfb	Humid continental with warm summers.
Portugal	Csa	Warm temperate with very warm dry summers.
	Csb	Warm temperate with warm dry summers.
Czech Republic	Dfb	Humid continental with warm summers.
Romania	Dfb	Humid continental with warm summers.
United Kingdom	Cfb	Warm and humid temperate with warm summers.
Slovakia	Dfb	Humid continental with warm summers.
Slovenia	Cfb	Warm and humid temperate with warm summers.

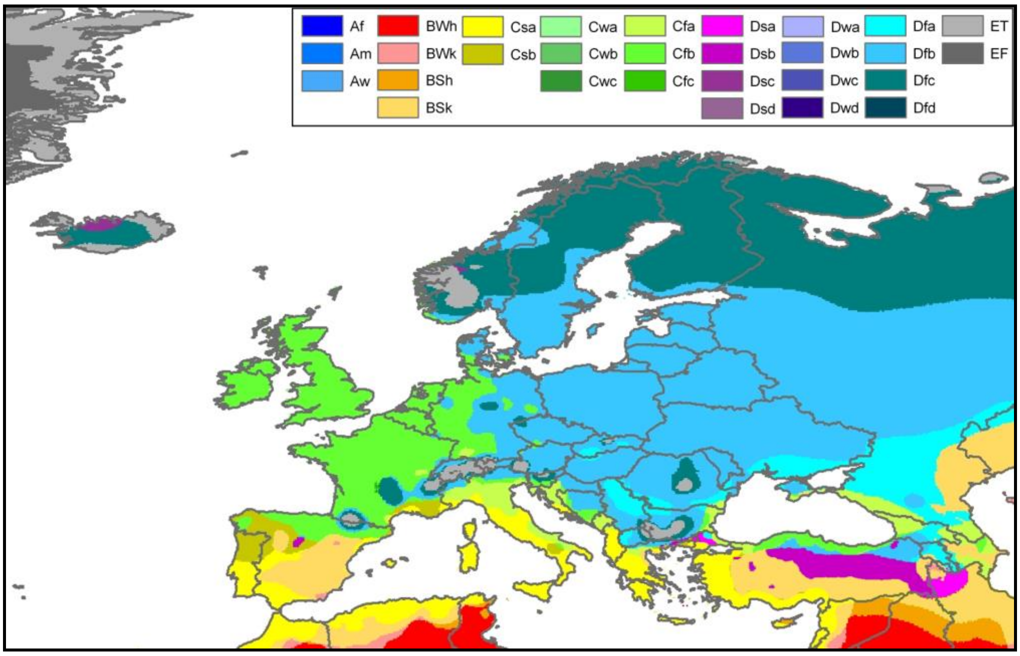

Figure 6 – Map of climates observed in the PRA area (Source: Köppen Geiger)

2.2.1.5 Potential for economic consequences in the PRA area

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 and other negative economic impacts (on the environment, on society, on export markets) through the effect on plant health in the PRA area?

Yes

A. trifida can have negative economic impacts, impacts on human health or cause damage to other plants.

In its current range, *A. trifida* is known to be a very competitive plant with respect to other cultivated species, and induces considerable losses to farming, mainly because of its rapid and extensive development and its allelopathic properties. The competitive power of *A. trifida* can be seen from the size of the seedling at the four-leaf stage, which is already very large (Figure 7).

A. trifida can therefore affect yields of several species of economic interest: maize, cotton and soybeans. In the United States, yield losses in maize crops due to *A. trifida* vary from 5% when *A. trifida* densities are low to 19% when densities are higher (2 plants.m^{-2}) (Harrison *et al*., 2001; Williams and Masiunas, 2006; Johnson *et al*., 2007). For soybean crops, yield losses associated with the presence of *A. trifida* range from around 45 to 77% (Baysinger and Sims, 1991; Webster *et al*., 1994). These species with which *A. trifida* enters into competition are all grown in the PRA area. Occasionally, soybean crops in south-west France have been partly destroyed rather than being harvested because of the presence of *A. trifida* (personal communication, A. Rodriguez).

The abundance of some nematode species populations may be reduced in the presence of *A. trifida*. According to Wang *et al.* (1998), molecules produced by the roots of *A. trifida* may be responsible for this decrease in abundance. Indeed, the roots of *A. trifida* release thiarubrine A and thiophene A, molecules that exhibit biocidal properties.

Like other ragweed, *Ambrosia trifida* has very allergenic pollen, which can cause pollinoses (rhinitis, conjunctivitis, asthma and dermatitis) (Déchamp, 2013; Plank *et al.,* 2015). These allergies have been known and combated since the early 20th century, and today can also affect tourism. In the

United States, the State of Oregon has launched campaigns to eradicate the species and mentions the fact that it is "ragweed free" to promote tourism (Parsons and Cuthbertson, 2001).
In the PRA area, however, the populations are not currently large enough to cause significant allergy problems. The Working Group has not found anywhere in the PRA area where allergies can be specifically attributed to *A. trifida*.

Figure 7 – *A. trifida* seedling. The diameter of the plant is already 20 cm at the 4-leaf stage (Ragweed Observatory)

Lastly, in the United States, *A. trifida* is described as a host plant of *Xylella fastidiosa* (Black, 2004)**.**

2.2.1.6 Conclusion of pest categorisation

1.18 This pest could present a phytosanitary risk to the PRA area (Summarise the main elements leading to this conclusion)

Yes
A. trifida could present a phytosanitary risk to the PRA area. *A. trifida* presents risks to the economy, agricultural production and human health (Table 5, www.cabi.org/cpc).
Its strong development capacity and its allelopathic properties make it a potentially very harmful species for crops (Wang *et al*., 2005; Harrison *et al.*, 2001).
This species has a very allergenic pollen that contributes to the pollinoses observed in summer in genetically predisposed people. These allergies can also have a negative impact on tourism (Parsons and Cuthbertson, 2001).

As the species was introduced by imports of seed lots (maize, wheat, soybeans, rice, barley and clover), feed for animals and products intended for use in food or in the food industry (soybeans, maize) (Shamonin and Smetnik, 1986), it could affect international trade and exchanges (Karnkowski, 2001).

Lastly, *A. trifida* does not seem to have reached the limits of its potential distribution range in the EU. In countries that are already infested, until now most populations have remained limited in density and surface area, but they have the potential for local expansion. At European level, the species can expand its range to other Member States that have a climate conducive to its development.

Table 5 – Summary of the effects of *A. trifida* (Source: www.cabi.org/cpc)

Category	Impact
Animal/plant product	Negative
Biodiversity	Negative
Agricultural production	Negative
Environment (in general)	Negative
Fishing and aquaculture	None
Forest production	None
Human health	Negative
Livestock production	Negative
Native fauna	Negative on certain species
Native flora	Negative
Rare or protected species	None
Tourism	Negative
International trade and relations	Negative
Transport/travel	None

2.2.2 Section B: Assessment of the probability of introduction and spread and of potential economic consequences

2.2.2.1 Probability of introduction and spread

Introduction, as defined by the FAO Glossary of Phytosanitary Terms, is the entry of a pest resulting in its establishment.

2.2.2.1.1 Probability of entry of a pest

2.2.2.1.1.1 Identification of pathways

2.01 List the relevant pathways.

Examples of pathways are:

- **Plants for planting**
  - plants for planting (except seeds, bulbs and tubers)
  - bulbs or tubers
  - seeds
- **Plant parts and plant products**
  - cut flowers or branches
  - fruits or vegetables
  - grain
  - pollen
  - stored plant products
- **Wood and wood products**
  - non-squared wood
  - squared wood
  - bark
  - wooden packaging material

Other possible pathways
  - soil/growing medium
  - agricultural machinery
  - passengers
  - hitchhiking
  - plant waste
  - natural spread
  - manufactured plant products

Go to point 2.02

Ambrosia trifida was introduced into Europe via seed from crops imported from North America (Follak *et al*., 2013; Chauvel *et al*., 2015). The following in particular can be mentioned:
- spring wheat seed (Follak *et al*., 2013): historical vector,
- soybean seed (Chauvel *et al*., 2015): presumed current vector,
- maize seed (Chauvel *et al*., 2015): presumed current vector,
- seed of other spring crops (sunflower, sorghum).

Other vectors of accidental introduction, more anecdotal, can be mentioned:
- contaminants in fodder for horses imported into the American camps in the First World War (Brandicourt, 1918),
- contaminants from a stock of straw introduced into Poland in 1903 (from Chauvel *et al*., 2015),
- contaminants of cotton fibres introduced for the textile industry and found in a field fertilised with cotton compost in Issenheim (France) in 1971 (Herbier G.),
- wool contaminants (Verloove, 2006).

2.02 Select from the relevant pathways, using expert judgement, those which appear most important.

Go to point 2.03

The pathways of historical accidental introduction are not considered to be very relevant today (contaminants of fodder, straw, cotton).

The most hazardous current pathways of introduction concern **seed for sowing:**

- soybean seed (Chauvel *et al*., 2015): presumed current vector,
- maize seed (Chauvel *et al*., 2015): presumed current vector,
- seed of other spring crops (sunflower, sorghum).

2.2.2.1.1.2 Probability of the pest being associated with the individual pathway at origin.

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 unlikely, unlikely, moderately likely, likely, very likely

Level of uncertainty:	Low	Medium	High

Go to point 2.04

Ambrosia trifida can heavily infest maize and soybeans in the United States and Canada (Regnier *et al*., 2016). It is listed as one of the most significant and costly species in terms of harmfulness in Illinois, Indiana, Ohio, Oklahoma and Kentucky (Johnson *et al.,* 2004; Jordan, 1985; Loux and Berry, 1991). *A. trifida* produces seeds from late summer into autumn. All the crops mentioned above are harvested at a time when the seeds of *A. trifida* are present and largely mature. In infested fields, seed crops have a high probability of being contaminated by seeds of *A. trifida*.

The probability that seeds of *A. trifida* are associated with the pathway at the point of origin depends mainly on the exact origin of the imported product and the degree of infestation of this region by *A. trifida*.

Level of uncertainty: Medium

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 unlikely, unlikely, moderately likely, likely, very likely.

Level of uncertainty:	Low	Medium	High

Go to point 2.05

In the area of origin, combining certain cropping practices (management of the species at the outer edges, succession of crops, tillage and more diversified spectrum of herbicides) may limit infestations of *A. trifida* (Regnier *et al*., 2016). In soybean and maize, populations of *A. trifida* have been resistant to acetolactate synthase (ALS) inhibitors (chlorimuron-ethyl, cloransulam-methyl, imazamox, imazaquin, imazethapyr, primisulfuron-methyl and prosulfuron) since 1998 and to glyphosate since 2004. Some populations even have multiple resistance to ALS inhibitors and glyphosate (Heap, 2017). This situation poses many management problems and populations are often abundant in the fields.
In the PRA area, the withdrawal of certain highly persistent herbicides such as trifluralin in crops such as sunflower means that it is no longer possible to control the late germination of this type of species (personal communication B. Chauvel).

Seed sorting practices by companies producing certified seed can however limit the risk of association of giant ragweed with the pathway at the point of origin. *A. trifida* used to be regularly observed in docks, as a casual species that escaped from imported goods. A sharp fall in observations in docks from the 1970s was interpreted as a consequence of the cessation of imports of goods in bulk and improvements in seed cleaning techniques (http://www.brc.ac.uk/plantatlas/index.php?q=plant/ambrosia-trifida).

But a few impurities still remain. Several references indicate the presence of *A. trifida* in maize seed imported from the United States (Australia, Poland, Egypt (https://www.ippc.int/sites/default/files/documents/20140211/09_ewgcutflowers_2014_june_weedriskanalysisproposedimportationmaizefromusa_2014-02-11_tl_201402111123--1.99%20MB.pdf)).

Level of uncertainty: Medium
The likelihood that *A. trifida* seeds are associated with the pathway at the point of origin greatly depends on the effectiveness of the management measures implemented during cultivation, the degree of resistance of local populations to glyphosate or to ALS inhibitors, and the cleaning procedures that can be implemented at the origin before export.

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 unlikely, unlikely, moderately likely, likely, very likely

Level of uncertainty:	**Low**	**Medium**	**High**

Go to point 2.06

Significant volumes of maize and soybean seed are imported each year into the European Union. Thus, between 1999 and 2011, an average of 77.2 million and 29.9 million tonnes of maize seed were introduced each year from the United States and Canada respectively. For soybean seed the volumes are lower and represent an average of 9716 and 1728 tonnes introduced each year from the United States and Canada respectively (source EUROSTAT).
The large volumes of seed and grain likely to be contaminated and imported into the EU from the United States and Canada leads the experts to consider that the risk of regular introductions of *A. trifida* seeds is moderately likely with medium uncertainty, because the risk depends largely on the degree of infestation of the exact region of origin.

Level of uncertainty: Medium

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 unlikely, unlikely, moderately likely, likely, very likely

Level of uncertainty:	Low	Medium	High

Go to point 2.07

Precise data on the frequency of movement along the pathway are not available. The frequency of seed imports is regular, with equivalent volumes each year (an increase for maize, a decrease for soybeans).
The frequency of movements along the pathway has no impact on the viability of the seeds introduced or on their quantity. Only the volumes imported can have an impact on the likelihood of introduction.

Level of uncertainty: Medium

2.2.2.1.1.3 Probability of survival during transport or storage

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

very unlikely, unlikely, moderately likely, likely, very likely

Level of uncertainty:	Low	Medium	High

Go to point 2.08

The seeds of *A. trifida* can remain viable for up to four years (Harrison *et al*., 2003). There is no doubt about their ability to survive during the transport of grain or seed for sowing.

Level of uncertainty: Low

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

very unlikely, unlikely, moderately likely, likely, very likely

Level of uncertainty:	Low	Medium	High

Go to point 2.09

Inappropriate question for plants: seeds do not multiply.

2.2.2.1.1.4 Probability of the pest surviving existing pest management procedures

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

very unlikely, unlikely, moderately likely, likely, very likely.

Level of uncertainty:	Low	Medium	High

Go to point 2.10

There are no inspection measures concerning this species and weeds in general for seed lots arriving in France and in the European Union. Directive 2000/29/EC on plant protection only concerns exotic species of the genus *Arceuthobium*, a parasite of softwood.

Level of uncertainty: Low

2.2.2.1.1.5 Probability of transfer to a suitable host or habitat

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

very unlikely, unlikely, moderately likely, likely, very likely

Level of uncertainty:	**Low**	**Medium**	**High**

Go to point 2.11

Seed for sowing contaminated by *A. trifida* is directly sown in agricultural fields, which are an optimal habitat for this species. This is particularly the case with soybean or maize fields when irrigated. On the other hand, in the areas of introduction such as ports, airports or freight stations where cargoes of seed for sowing or grain for industry or livestock pass through, any seeds falling to the ground would have more difficulty becoming established as shown by the species' historical decline in such sites (Chauvel *et al*., 2015), with a disappearance from all the historical stations.

Level of uncertainty: Low

2.11 The probability of entry for the pathway should be evaluated

very unlikely, unlikely, moderately likely, likely, very likely

Level of uncertainty:	**Low**	**Medium**	**High**

Go to point 2.12

Introduction by means of imports of soybean and maize seed for sowing or grain for livestock feed or the agri-food industry is likely since *A. trifida* has become one of the major weeds of these crops in the area of origin of its imports (United States Corn Belt), it is difficult to manage, and crops free of its seeds cannot be guaranteed. The significant and regular volumes of soybean and maize seed introduced from the United States and Canada, the lack of specific inspection measures, and the direct introduction into a favourable habitat all constitute factors promoting the probability of entry.

Level of uncertainty: Medium

2.2.2.1.1.6 Other sectors taken into account

2.12 Do other pathways need to be considered?

if yes — **Go back to point 2.02 for the next pathway**

if no: — **Go to point 2.13 and then to point 3.01**

No

2.2.2.1.1.7 Conclusion on the probability of entry

2.13 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 unlikely, unlikely, moderately likely, likely, very likely

Level of uncertainty:	**Low**	**Medium**	**High**

Go to point 3.01

See answer to question 2.11

2.2.2.1.2 Probability of establishment

Selecting 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

The purpose of the following table is to enable the selection of only those factors that need to be assessed:

No.	**Factor**	**Column A** **Is the factor likely to have an influence on the limits to the area of potential establishment?**	**Column B** **Is the factor likely to have an influence on the suitability of the area of potential establishment?**	**Justifications**
1	Host plants and suitable habitats (*see note for Q3.01*)	Answer Q3.01. NO, see Q3.01.	Answer Q3.09.	
2	Alternate hosts and other essential species (*see note for Q3.02*)	Only if relevant, answer YES or NO. If YES, answer Q3.02. If NO, provide a justification. NO	Only if relevant, answer YES or NO. If YES, answer Q3.10. If NO, provide a justification. NO	The pollen of *A. trifida* is transported by the wind, and the plant only occasionally attracts a few insects, which are not essential for its reproduction.
3	Climatic suitability (*see note for Q3.03*)	Answer Q3.03. YES, see Q3.03.	Answer Q3.11. YES, see Q3.11.	

4	Other abiotic factors (*see note for Q3.04*)	Answer YES or NO. If YES, answer Q3.04. If NO, provide a justification. NO	Answer YES or NO. If YES, answer Q3.12. If NO, provide a justification. YES, see Q3.12.	Soils favourable to the species are present and relatively frequent across the entire PRA area. Even if the edaphic conditions can influence the local probability of establishment of *A. trifida*, these conditions should not influence the limits of the potential area of establishment.
5	Competition and natural enemies (*see note for Q3.05*)	Answer YES or NO. If YES, answer Q3.05. If NO, provide a justification. NO.	Answer YES or NO. If YES, answer Q3.13. If NO, provide a justification. YES, see Q3.13.	In the natural environment, the presence of native competitor plants can influence the habitat's degree of invasibility for *A. trifida*. Nevertheless, because of rapid colonisation of bare soil and a competitive advantage linked to rapid germination and development, it is unlikely that the potential area of establishment of *A. trifida* would be reduced by competition with other ruderal species. In the agricultural environment, it is also unlikely that competition with cultivated plants would prevent the establishment of the species. The species has, moreover, few natural enemies in the PRA area likely to reduce its potential for establishment (Kiss, 2007).

6	The managed environment (*see note for Q3.06*)	Answer YES or NO. If YES, answer Q3.06. If NO, provide a justification. YES, see Q3.06.	Answer Q3.14 and 3.15. YES, see Q3.14 and 3.15.	
7	Protected cultivation (*see note for Q3.07*)	Answer YES or NO. If YES, answer Q3.07. If NO, provide a justification. NO	Answer YES or NO. If YES, answer Q 3.16. If NO, provide a justification. NO	*A. trifida* is not known as a weed of crops grown under shelter. It is unlikely that the species grows to maturity in protected cultivation; this factor is therefore not likely to influence the establishment of the species.

2.2.2.1.2.1 Identification of the area of potential establishment

2.2.2.1.2.1.1 Factor 1. 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).

Ambrosia trifida grows in different types of herbaceous communities, including ruderal habitats and cultivated fields, on rather rich and moist soil (Bassett and Crompton, 1982; Hartnett *et al*., 1987; Krippel and Colling, 2006). It is also found in damp natural environments, particularly on river banks (Sickels and Simpson, 1985).

The species can grow, at least, in the following habitats categorised according to the EUNIS classification (Davies *et al.,* 2004):
C: Inland surface waters;
E: Grasslands and lands dominated by forbs, mosses or lichens;
I: Regularly or recently cultivated agricultural, horticultural and domestic habitats;
X: Habitat complexes.

A. trifida seems to preferentially become established in crops (I1) and ruderal environments (E). It is also found by in the littoral zone of inland surface waterbodies (C3), bare tilled, fallow or recently abandoned arable land (I1-5), road networks (J4-2), rail networks (J4-3) and domestic and non-domestic gardens (X).
These habitats are found throughout the European Union. The type of habitat is not therefore likely to have an influence on the limits to the area of potential establishment.

2.2.2.1.2.1.2 Factor 2. Alternate hosts and other essential species

3.02 Does all the area identified in 3.01 have alternate hosts or other essential species if these are required to complete the pest's life cycle?

If not required: Record this information.

Go to the next question.

No

Ambrosia trifida is an annual plant species capable of completing its development cycle without other species.

2.2.2.1.2.1.3 Factor 3. Climatic suitability

3.03 Does all the area identified as being suitable for establishment in previous questions have a suitable climate for establishment?

If yes: Record this information and provide justification
If no: 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.

Go to the next question.

No

There are regions of the PRA area where the climatic conditions are not suitable for the establishment of *A. trifida* (see Annex 2).

Follak *et al*. (2013) modelled the climatic zones favourable to the species, in central and eastern Europe. According to these authors, because the species is constrained by temperature and precipitation, only 16% of the territory considered (central Europe) would be climatically favourable to the species. The species currently occupies less than 1.5% of the climatically favourable areas in central and eastern Europe.

On the basis of the current distribution data (covering the area of origin and the area of introduction) an ecological niche model with the MaxEnt algorithm (Elith *et al*., 2011) was produced using Worldclim climate data (http://www.worldclim.org/) over the 1960-1990 period at a resolution of 30 seconds (0.86km² at the equator). European populations regarded as casual (historical observations not confirmed recently) were not taken into account (see Annex 2 for more details). Three Bioclim variables (Hijmans *et al*., 2005) were selected on the basis of the biology of the species (annual with spring germination and a summer cycle): mean diurnal temperature range (monthly mean of the difference between max. and min. temperature, BIO2), mean temperature of the warmest quarter (BIO10), and precipitation of the warmest quarter (BIO18). MaxEnt favours the model's predictive ability compared to its explanatory ability in terms of ecological importance of the climate variables. This bias reflects our objective in the framework of the pest risk analysis, which is above all to estimate the potential area of geographic distribution of *A. trifida*. The contributions of the three variables in the construction of the model were respectively 56.4%, 36.3% and 7.3% for BIO10, BIO18 and BIO2.

Figure 8 shows the degree of similarity between the climate envelope of the occurrences and the climatic conditions that prevail at the level of each pixel of the map. This map of probability (values from 0 to 1) can be transformed into a map of presence-absence (values of 0 or 1) by determining a threshold of probability above which it is considered that the species is present. Figure 9 shows the areas (green) for which the degree of similarity is greater than the threshold maximising simultaneously sensitivity (probability that the species is predicted when it is present) and specificity (probability of predicting an absence when the species is absent).

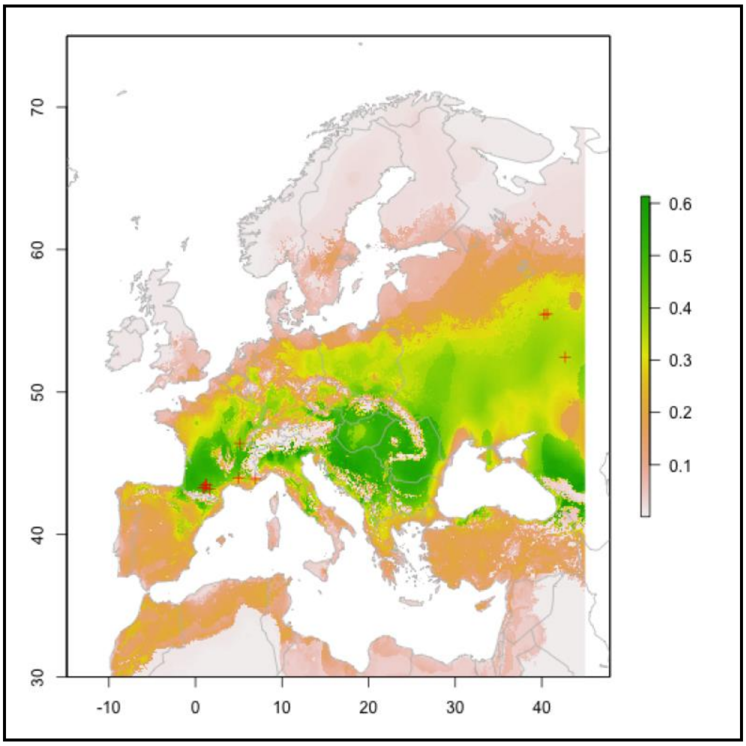

Figure 8 – Detail of the climatically compatible area for Europe. The occurrence points are shown in red. The index varies between 0 (conditions unfavourable to the species) and 1 (perfect conditions).

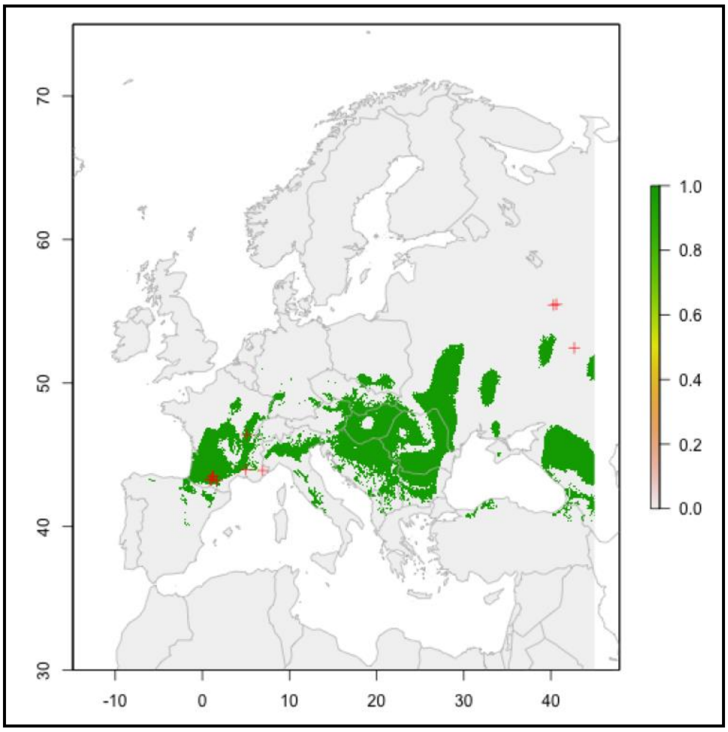

Figure 9 – Model predictions for Europe. The occurrence points are shown in red. The green areas correspond to climate compatibility values above the threshold maximising simultaneously the model's sensitivity and specificity.

The model's results show that *A. trifida* encounters favourable climatic conditions in France (in the south-west, the valleys of the Rhône, the Saône and the Rhine), Spain (north-east), northern Italy (mainly the plain of the Po), very locally in Switzerland, in southern Germany, southern Poland, the southern Czech Republic and Slovakia, eastern Austria, Hungary, northern Slovenia, Croatia, Bulgaria and Romania.

These results suggest that a large part of the PRA area can still be colonised by *A. trifida*.

2.2.2.1.2.1.4 Factor 4. Other abiotic factors

3.04 Does all the area identified as being suitable for establishment in previous questions have other suitable abiotic factors for establishment?

> **If yes:** Record this information and provide justification.
> **If no:** Based on the area assessed as being suitable for establishment in previous questions, identify and describe the area that is not under protected cultivation where additional abiotic factors that can affect establishment are favourable. Describe how this affects the area identified where hosts, suitable habitats and other essential species are present.

Go to the next question.

Yes
The good water retention capacity of some agricultural soils and agro-systems is particularly favourable to the establishment of *A. trifida* (data interpreted with respect to Bassett and Crompton, 1982).

<u>Factor 5. Competition and natural enemies</u>
3.05 Is all the area identified as being suitable for establishment in previous questions likely to remain unchanged despite the presence of competitors and natural enemies?

> **If yes:** Record this information and provide justification,
> **If no:** Identify and describe any locations where the area suitable for establishment based on previous questions is likely to be altered due to competition and natural enemies. Provide justification.

Go to the next question.

Yes
In ruderal environments contiguous to agricultural areas, due to preferential colonisation of bare soil and a competitive advantage linked to rapid germination and development (Bassett and Crompton, 1982), it is unlikely that the potential area of establishment of *A. trifida* would be reduced by competition with other ruderal species. In the agricultural environment, it is also unlikely that competition with cultivated plants would prevent the establishment of the species. Like *A. artemisiifolia* (Kiss, 2007), *A. trifida* has few natural enemies in the PRA area likely to reduce its establishment potential.
In contrast, in stable natural environments (meadows dominated by perennial grasses), interspecies competition may limit the installation of this annual species.

2.2.2.1.2.1.5 Factor 6. The managed environment

3.06 Is all the area identified as being suitable for establishment in previous questions likely to remain unchanged despite the management of the environment?

> **If yes:** Record this information and provide justification,
> **If no:** Identify and describe any locations where the area suitable for establishment based on previous questions is likely to be altered due to the management of the environment. Provide justification.

Go to the next question.

No
There is little likelihood that this species could become established in regions without 1) spring and summer crops associated preferentially with reduced tillage (opening of the environment), and 2) sufficient rainfall or irrigation (Regnier *et al*., 2016).

2.2.2.1.2.1.6 Factor 7. Protected cultivation

3.07 Are the host plants grown in protected cultivation in the PRA area? If the pest is a plant, has it been recorded as a weed in protected cultivation elsewhere?

> **If no:** Record this information and provide justification.
> **If yes:** Identify and describe the areas where the hosts are grown in protective cultivation or – if the pest is a plant – where similar protected cultivation occurs in the PRA area. Provide justification.

Go to the next question.

No
A. trifida has not been reported as a weed in protective culture.

2.2.2.1.2.1.7 Area of potential establishment

3.08 By combining the cumulative responses to those questions 3.01 to 3.06 that have been answered 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.

The part of the PRA area where there are suitable habitats corresponds to cultivated fields and contiguous habitats in France (in the south-west, the valleys of the Rhone, the Saône and the Rhine), Spain (north-east), northern Italy (mainly the plain of the Po), very locally in Switzerland, in southern Germany, southern Poland, the southern Czech Republic and Slovakia, eastern Austria, Hungary, northern Slovenia, Croatia, Bulgaria and Romania. These are the areas most favourable to the establishment of *A. trifida*. This includes mainly ocean-type climates and continental climates with warm summers but no dry season.
Irrigation could increase the boundary of the favourable area (Mediterranean area, which is naturally too dry in summer).
In the favourable climate envelope, the banks of water courses also represent environments that are quite conducive to its installation.

2.2.2.1.2.2 Suitability of the area of potential establishment

2.2.2.1.2.2.1 Availability of suitable hosts or suitable habitats, alternate hosts and vectors in the PRA area

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

very unlikely, unlikely, moderately likely, likely, very likely

Level of uncertainty:	Low	Medium	High

Habitats that are currently "agricultural habitat" and "river bank" promote the establishment of *A. trifida.* The agricultural areas are very large with many adjacent fields and are also linked by agricultural practices (seed, agricultural equipment).
In the second habitat (river bank), the seeds of *A. trifida* can potentially be dispersed by the water courses.

Level of uncertainty: Low

3.10 How likely is the distribution of alternate hosts or other species critical to the pest's life cycle in the area of potential establishment to favour establishment?

very unlikely, unlikely, moderately likely, likely, very likely

Level of uncertainty:	Low	Medium	High

There is no species essential for completing the cycle of *A. trifida* and likely to promote its establishment.

2.2.2.1.2.2.2 Suitability of the environment

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?

Not similar, slightly similar, moderately similar, largely similar, completely similar

Level of uncertainty:	Low	Medium	High

The species is already naturalised in part of the European Union, in south-west France and northern Italy (current area of distribution).

According to its current area of distribution, *A. trifida* is present under different types of precipitation regime, with annual levels of precipitation ranging from 400 to 2500 mm, but it prefers summer precipitation regimes and does not tolerate periods of drought. The average monthly temperatures in the warmest month vary from 15°C to 30°C (CABI).

The potential distribution of *A. trifida* in Europe (Figures 8 and 9) was determined with the MaxEnt algorithm (see Annex 2) on the basis of its current distribution (in its area of origin and its area of introduction). Therefore, the climatic conditions affecting the establishment of *A. trifida* in the potential area of distribution (France, Spain, Italy, Switzerland, Germany, Poland, Czech Republic, Slovakia, Austria, Hungary, Slovenia, Croatia, Bulgaria, Romania) are by nature largely similar to those in the current area of distribution. The Working Group considers that this model of distribution accurately reflects the potential extension of the species (large part of central Europe, south-eastern half of France, northern Italy) with some uncertainties for Mediterranean areas related to the species' local adaptation capabilities.

Level of uncertainty: Low

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

Not similar, slightly similar, moderately similar, largely similar, completely similar

Level of uncertainty:	**Low**	**Medium**	**High**

Abiotic factors favouring the development of *A. trifida* in the area of introduction are similar to those in the area of origin.
A. trifida seems indifferent to the texture and pH of the soil, but prefers soils that are relatively rich in nutrients (classified as n' = Plant responding well to manuring in Jauzein, 1995), and soils that are relatively moist.

Level of uncertainty: Low

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

very unlikely, unlikely, moderately likely, likely, very likely

Level of uncertainty:	**Low**	**Medium**	**High**

A. trifida is already established in certain favourable environments of the PRA area. In cultivated environments, it is not affected by any phenomenon of competition that could limit its establishment. In contrast, on river banks and in wet grasslands, natural vegetation may hinder its development. Moreover, for the moment, there is no known specific enemy of *A. trifida* in the PRA area.

Level of uncertainty: Low

2.2.2.1.2.2.3 Cultural practices and control measures

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

Not at all favourable, slightly favourable, moderately favourable, highly favourable, very highly favourable

Level of uncertainty:	**Low**	**Medium**	**High**

The frequency of spring and summer crops such as maize, soybeans and sunflower in the crop rotation system (tillage and irrigation) is a factor that strongly promotes the establishment of *A. trifida* once the field has become contaminated by this weed species. Monocultures of spring and summer crops as well as reduced tillage are likely to promote *A. trifida* (Regnier *et al*., 2016). Irrigation could also favour this meso-hygrophilic species, particularly beyond its climate envelope in areas where the limiting factor is the level of summer precipitation (areas of southern Europe).

Level of uncertainty: Low

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

very unlikely, unlikely, moderately likely, likely, very likely.

Level of uncertainty:	**Low**	**Medium**	**High**

The standard cultivation methods used with spring or summer crops that are favourable to the development of *A. trifida* (soybeans and sunflower) are not sufficient to limit the development of this species.
In addition, the reduction in the number of herbicide compounds and the decrease in the number of treatments associated with the reduction in the use of plant protection products (herbicides) are factors that promote the establishment of *A. trifida*.
In contrast, in crop systems where different weed control practices are used, in maize crops, conventional broad-leaf pre-emergent (mesotrione, thiencarbazone-methyl) and/or post-emergent (e.g. dicamba and 2,4-D) herbicides should be able to effectively prevent the installation of this species.

Level of uncertainty: Medium
The effectiveness of pest management practices can vary according to the conditions of their implementation.

3.16 Is the pest likely to establish in protected cultivation in the PRA area?

Yes
No

Level of uncertainty:	**Low**	**Medium**	**High**

No
A. trifida has no chance of being maintained under glass due to its systematic mechanical removal as soon as it appears.

Level of uncertainty: Low

2.2.2.1.2.2.4 Other characteristics of the pest affecting the probability of establishment

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

very unlikely, unlikely, moderately likely, likely, very likely

Level of uncertainty:	**Low**	**Medium**	**High**

A. trifida is a summer species with a cycle largely similar to that of the crops in which it develops. In addition, its seeds have a life span in soil of at least four years (Harrison *et al*., 2007). These different elements of the life cycle and mode of reproduction of *A. trifida* are likely to promote its establishment.

Level of uncertainty: Low

3.18 Is the pest highly adaptable?

YES, highly or very highly adaptable
NO, moderately adaptable or less / Not relevant

Level of uncertainty:	**Low**	**Medium**	**High**

Yes, highly adaptable
Many herbicide-resistant populations of *A. trifida* are known in its area of origin, however no mention of this phenomenon has so far been reported in the PRA area. It is likely that it will be seen in the near future, particularly for example in crops tolerant to ALS inhibitors.

Level of uncertainty: Medium

3.19 How widely has the pest established in new areas outside its original area of origin? (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)

Not established in new areas, not widely, moderately widely, widely, very widely

Level of uncertainty:	**Low**	**Medium**	**High**

Moderately established in new areas

To date, the species has only become established on two new continents (Europe, Asia) and only in regions with a warm and humid temperate climate with warm summers (Cfb according to the Köppen-Geiger classification). The populations found in the PRA area are still limited, whereas they are already very large in China.

Level of uncertainty: Low

2.2.2.1.2.3 Conclusion on the probability of establishment

3.20 The overall probability of establishment should be described.

Very low, low, medium, high, very high

Level of uncertainty:	**Low**	**Medium**	**High**

The overall probability of establishment of *A. trifida* is considered to be high because of high climate compatibility (see Annex 2), widespread favourable habitats and an insufficient incidence of management and natural regulation factors (weeding of the cultivated plots, absence of natural enemies) to prevent its installation.
A. trifida is already established in the PRA area in south-west France, the plain of the Po (Italy) and many other countries of Europe (Follak *et al*., 2013), since at least 2000, and the life span of the seeds of this species in soil favours its long-term persistence. Depending on the climatic and environmental compatibilities, other areas could become colonised.

Level of uncertainty: Low

2.2.2.2 Probability of spread

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

Very low rate of spread, low rate of spread, moderate rate of spread, high rate of spread, very high rate of spread

Level of uncertainty:	Low	Medium	High

The seeds of *A. trifida* are large in size (achene 0.5 to 1.2 cm long) and naturally spread mainly by barochory and hydrochory. In the case of barochory, dispersal takes place over very limited distances (a few metres around the mother plant). In contrast, for populations growing near rivers or on sloping land, dispersal by hydrochory may carry the seeds a great distance (several kilometres). The speed and distance of dispersal can therefore vary greatly according to the situation of the contaminated area in the toposequence and depending on the presence of a water course in the immediate vicinity. The seeds can be displaced from a few centimetres (earthworms) to a few metres (rodents) (Goplen *et al.,* 2016; Harrison *et al.*, 2003; Payne, 1962; Regnier *et al.*, 2008) by animal species in agrosystem communities.
The uncertainty on this issue is considered to be medium because of the limited number of bibliographic references on the topic and the hypothetical role of birds in this dispersion.

Level of uncertainty: Medium

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

Very low rate of spread, low rate of spread, moderate rate of spread, high rate of spread, very high rate of spread

Level of uncertainty:	Low	Medium	High

The rate of spread by human assistance can be very high, either by contamination of crops intended for seed or as feed for livestock or wild animals, or dispersal of seeds by agricultural machinery. This is particularly the case with harvesters operating in contaminated fields of soybean, maize or sunflower seed. Because some seeds are still attached to the plant at the time of harvest (Goplen *et al*., 2016), *A. trifida* can be dispersed by combine harvesters, which may then transfer the seeds to any other fields they subsequently visit.
In France, imports of seed for spring-grown species are not subject to any specific regulations with regard to ragweed. Only the intentional introduction of *Ambrosia artemisiifolia*, *psilostachya* and *trifida* seeds is regulated by the Ministerial Order of 26 April 2017. In Poland and Lithuania, *A. trifida* is a quarantine organism. In the EU, grain intended for bird feed is subject to regulations that severely restrict the presence of seeds of species of the genus *Ambrosia* (50 mg.kg^{-1} of grain, Regulation (EU) 2015/186 of 6 February 2015).

Level of uncertainty: Low

2.2.2.2.1 Conclusion on the probability of spread

4.03 Describe the overall rate of spread

Very low rate of spread, low rate of spread, moderate rate of spread, high rate of spread, very high rate of spread

Level of uncertainty:	**Low**	**Medium**	**High**

In conclusion, the rate of spread is considered to be high because of the combination of different factors of natural and anthropogenic dispersal.

Level of uncertainty: Medium

Although the seeds of *A. trifida* are large in size (0.5 to 1.2 cm long) and mainly barochorous, the high probability of their long-distance dispersion by hydrochory, or as a contaminant of crops or seed, or their ability to be transported by agricultural machinery, particularly harvesters, leads us to consider the rate of spread of this species in the PRA area as high, with medium uncertainty, because spatial progression of populations will greatly depend on anthropogenic actions and the effectiveness of the means for preventing spread and managing the populations already present.

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:	**Low**	**Medium**	**High**

The areas favourable to the development of *A*. *trifida* are currently isolated from each other. Contamination of the entirety of a favourable area may be fairly rapid (a few years) once the species establishes a presence. However, contamination from one zone to another will be much slower if the ecologically favourable areas are far away from each other and the harvesting machines do not circulate from one area to another, or if these areas are not crossed by the same river passing through a contaminated area.

Several decades will be necessary. As a comparison, another annual species of the genus *Ambrosia*, which is more dynamic and has less strict soil and climate requirements (*A. artemisiifolia*), has not yet colonised all the areas of potential establishment after more than 150 years of presence in Europe.

Level of uncertainty: Low

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:	**Low**	**Medium**	**High**

The currently colonised areas are very small in relation to the area of potential establishment (around 50 fields in south-west France, a few in Italy). In five years, it is likely that the area of establishment remains very small, less than 0.01% of the area of potential establishment (see map: Figure 9 and Annex 2).

Level of uncertainty: Low

2.2.2.3 Eradication, containment of the pest and transient populations

This section evaluates the likelihood that the pest could survive eradication programmes or be contained in case of an outbreak within the PRA area. It also considers if transient populations are likely to occur in the PRA area through natural migration or entry through man's activities.

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

very unlikely, unlikely, moderately likely, likely, very likely

Level of uncertainty:	**Low**	**Medium**	**High**

There is not presently any programme for eradicating *A. trifida* on the scale of the PRA area. *A. trifida* is present in various environments, including natural damp environments (river banks) where implementation of an eradication programme is very difficult. The large size and morphological characteristics of individuals make identification of this species very easy, allowing early detection of any new incursion, which can help the rapid implementation of local eradication schemes.
As a problematic weed of crops, control measures for *A. trifida* seem very likely. While the use of pre-emergence (e.g. imazaquin) and/or post-emergence (e.g. dicamba and 2,4-D) herbicides allows effective control of the species on the scale of the agricultural plot (Soltani *et al.,* 2011; Vink *et al.,* 2012), this is rarely total (Soltani *et al.,* 2011). Moreover, many cases of resistance to herbicides have been reported in the area of origin (Heap, 2017; Vink *et al.,* 2012). Control then becomes more difficult to implement and requires a combination of tillage and pre- and post-emergence herbicide treatments to reduce the density of *A. trifida* at the beginning of the season, which would seem to provide an integrated approach for effective management of the species (Ganie *et al.*, 2017).
Tillage helps reduce the development of a population in an agricultural plot for a given year, but is not intended to eradicate the species. Furthermore, as *A. trifida* is capable of forming a relatively persistent seed bank with germination spread over time (Abul Fatih and Bazzaz, 1979), and of occupying non-agricultural habitats, it is likely, with a low uncertainty, that the conventional control measures considered will not be able to completely eradicate the species.

Level of uncertainty: Low

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?

very unlikely, unlikely, moderately likely, likely, very likely

Level of uncertainty:	**Low**	**Medium**	**High**

While eradication seems difficult, containment measures could help curb the invasion of the species within the PRA area. Limiting the local development of a population can be achieved by the use of herbicides (Soltani *et al.*, 2011), at least where this is possible, or by grubbing-up. Nevertheless, effective containment requires rapid detection and measures to prevent the dispersal of the species. There is no coherent surveillance system enabling early detection of invasion outbreaks on the scale of the PRA area. On cultivated land, early detection followed by rapid reasoned intervention can effectively contain a new outbreak of contamination. In addition, the species can be spread by land transport and agricultural machinery, via contaminated seed lots, or by flooding along water courses. These vectors are difficult to control: it therefore appears only moderately likely that the pest can be contained if an outbreak begins to develop in the PRA area.

Level of uncertainty: Medium

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
No

Level of uncertainty:	**Low**	**Medium**	**High**

Yes
There is a strong likelihood that transient populations of *A. trifida* are present in the PRA area following spread via human activities. Indeed, such fleeting populations have already been documented in the PRA area (EPPO, 2014; Royal Botanic Garden Edinburgh, 2003; Verloove, 2016) including France (Chauvel *et al*., 2015).

Level of uncertainty: Low

2.2.2.4 6. Assessment of potential economic consequences

2.2.2.4.1 Economic impact "sensus-stricto"

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, minor, moderate, major, massive

Level of uncertainty:	**Low**	**Medium**	**High**

In North America:
In its area of origin, the economic consequences associated with the presence of *A. trifida* are considered to be major from an agricultural point of view and a public health point of view.
In agricultural environments, the plant's significant and rapid development gives it a strong ability to enter into competition with different summer crops: soybean, cotton, maize. Even at very low densities (one plant per 25 m²), loss of crop yield (of around 5%) has been seen, a phenomenon rarely observed for other weeds (Harrison *et al.*, 2001). Yield reductions of 13 to 50% have been observed in classic crop situations, with the losses being even greater when the crop and the weed grow simultaneously (Barnet, 2012; Harrison *et al*., 2001; Webster *et al*., 1994). Figure 10 highlights the impact of *A. trifida* on yield as a function of its density. The development of resistance to certain herbicides over the past twenty years, including glyphosate and ALS inhibitors (Heap, 2017), brings additional complexity to the management of this species.
In 1994, Webster *et al*. estimated the loss of yield in the United States associated with *A. trifida* in soybeans to be 5 to 7% of the yield of the crop. A recent study (Regnier *et al*., 2016) among farmers in the United States showed that *A. trifida* was the most difficult weed to manage for 45% of them, while 57% also reported a problem of herbicide resistance, either to acetolactate synthase inhibitors or glyphosate (or resistance to both).

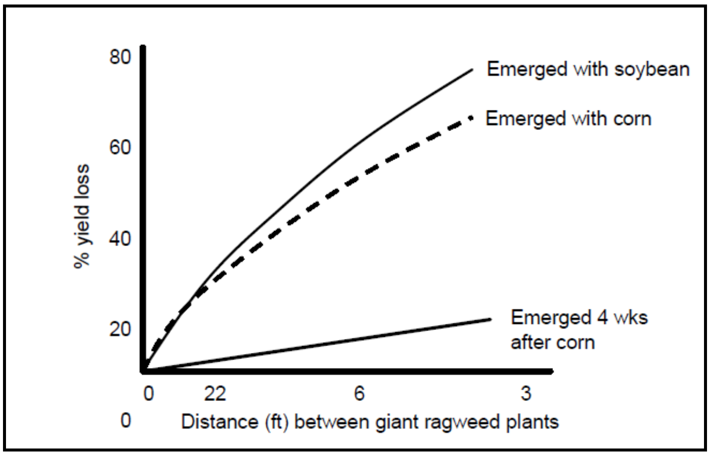

Figure 10 – Harmfulness of *A. trifida* in terms of yield (Werle *et al.*, 2004)

In grassland environments, *A. trifida* also represents a problem in operations to restore these environments (Meyeri, 2011) through its impact on the local flora.

The constraints caused by *A. trifida* are related primarily to the competition exerted by the species, but could also be linked to phenomena of allelopathy (Kong *et al.*, 2007).

In the PRA area, particularly in France, yield losses due to *A. trifida* have been observed that have led to the destruction of soybean crops that cannot be harvested (personal communication A. Rodriguez). But no quantitative data are currently available in this regard.

Level of uncertainty: Low

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, minor, moderate, major, massive

Level of uncertainty:	**Low**	**Medium**	**High**

Yield loss costs assessed at between a few hundred euros and a few thousand euros are mentioned in the region of Toulouse in soybean plots infested by *A. trifida*. However, no specific study has yet been conducted in this region that can be examined scientifically.
Farmers in this region report (personal communication, A. Rodriguez) additional operating costs associated with hand weeding, and even the destruction of plots before harvesting due to very high densities of *A. trifida*. It can therefore be considered locally that in the absence of control measures, the negative impact of this species on yield can be very high (Figures 12 and 13).
Based on the results of studies conducted in the United States (Ganie *et al.*, 2017) in 2013 and 2014, the absence of management measures against this species resulted in a total loss of maize yield, even at low weed densities (Figure 10). These results suggest the same level of impact in the PRA area if no control measures are implemented against *A. trifida*.

Level of uncertainty: Medium

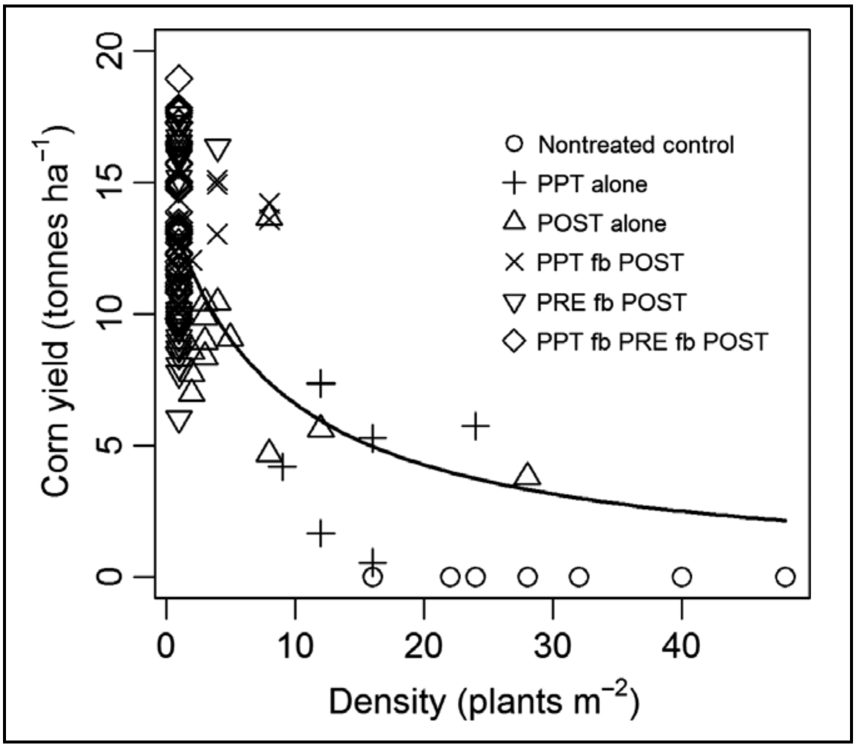

Figure 11 – Maize yield as a function of the density of *A. trifida* seedlings (Ganie *et al*., 2017)

Figure 12 and Figure 13 – High density of *A. trifida* in a plot of soybeans (left) and presence of *A. trifida* outgrowing irrigated maize (south of Toulouse; Ragweed Observatory)

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, minor, moderate, major, massive

Level of uncertainty:	**Low**	**Medium**	**High**

Without the implementation of integrated control against this species – effective chemical weed control, rotation including winter crops and appropriate tillage – the negative effects of *A. trifida* will probably increase, as suggested by the situation with certain plots in south-west France (Figure 14). However, until now, no quantified published information has been available concerning the extent of the negative effects of *A. trifida* in the PRA area. For this reason, the Working Group has assigned a medium level of uncertainty to this assessment.

Level of uncertainty: Medium

Figure 14 – High density of *A. trifida* (light green) in a plot of soybeans (dark green) subject to conventional technical methods (09/07/2017, G. Fried)

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, minor, moderate, major, massive

Level of uncertainty:	**Low**	**Medium**	**High**

As with many annual weeds, the conventional management practices used are far more effective when the stock of seeds is small and the density of emerging plants low.
With heavily infested plots, the negative effects on yield will be so high that specific measures such as rotations with crops unfavourable to the biology of *A. trifida* (winter cereals, green manure, etc.) will be the only effective means of reducing the high densities of *A. trifida.*

In Europe, it is not currently possible to quantify the economic impacts of this species. In France, in the region of Toulouse, farmers report (personal communication A. Rodriguez) additional costs associated with hand weeding, and even the destruction of plots before harvesting due to very high densities of plants, meaning the total loss of the crop. These costs (from a few hundred euros to a few thousand euros) have not yet been studied to a precise enough degree. At the national level, given the limited distribution of the species and the highly localised nature of the existing populations in the PRA area (Chauvel *et al*., 2015; Follak *et al*., 2013), the costs in terms of health or losses of agricultural yields attributable to this species are negligible so far.

Level of uncertainty: Low

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, minor, moderate, major, massive

Level of uncertainty:	**Low**	**Medium**	**High**

Any action targeting control of this species will generate an additional production cost (cost of weeding practices, establishment of less profitable crops, fallow with no yield whatsoever). In the absence of plant health regulations relating to the control of introduction into the PRA area of seed lots of maize, soybeans, sorghum and sunflower, the risk of introduction of herbicide-resistant genotypes of *A. trifida* appears high and such an introduction would result in a very high increase in control costs, based on the studies carried out in the United States (Ganie, 2017).
In the annual summer crops where it is present, *A. trifida* is managed like other weeds without it being subject to additional control measures. Note, however, the arrival on the market of sunflower varieties tolerant to herbicides intended to control species of the genus *Ambrosia* (and Asteraceae more generally). These varieties, through their tolerance to two herbicides from the class of ALS inhibitors, enable weed control in a post-emergence situation; they were placed on sale in 2010 to improve the post-emergence weed control of sunflower crops in general, and more specifically against *A. artemisiifolia.* These new varieties make it easier to manage the recent problems with *A. trifida.* However, the repeated use of such varieties and the associated herbicides risks causing the significant and rapid selection of populations of *A. trifida* resistant to these active ingredients in the PRA area, as is currently occurring with *A. artemisiifolia* (Chauvel and Gard, 2010).

Level of uncertainty: Low

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, minor, moderate, major, massive

Level of uncertainty:	**Low**	**Medium**	**High**

Some countries such as Russia, Israel, and Egypt refuse imports of cereals contaminated by species of the genus *Ambrosia*. *A. trifida* is not mature when winter cereals are harvested in Europe and will not directly contaminate these crops. On the other hand, it is mature at the time of harvesting summer crops (maize, soybean, sunflower and sorghum). Contamination of these crops could categorically prevent their export. As an example, in 2015 the maize export sector from the EU accounted for more than 63 million tonnes (Eurostat). There is a great risk of the additional costs of weed control and/or post-harvest sorting being reflected in market losses due to a higher production cost compared with situations free from *A. trifida.*

Level of uncertainty: Medium

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

No judgment possible/ask an economist, minimal, minor, moderate, major, massive

Level of uncertainty:	**Low**	**Medium**	**High**

Any additional cost generated by control of *A. trifida* or by degradation of the crop will be borne by the farmer, without any possibility of deferral, transfer or compensation. As an indication, farmers obliged to destroy the agricultural fields infested with *A. artemisiifolia* bear the entire cost and loss without any compensation. This is even more likely to occur given that compulsory control measures have been enacted in France, for example (https://www.legifrance.gouv.fr/eli/decret/2017/4/26/AFSP1626935D/jo/texte).

Level of uncertainty: Low

2.2.2.4.2 Environmental impact

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

N/A, minimal, minor, moderate, major, massive

Regarding the environmental aspect, there do not seem to be any data on this subject, except those on the problems of rehabilitation of fragile grassland environments in the United States (Meyeri, 2011). There are very few data in the invasion area on the environmental impact of infestations of *A. trifida*. In Japan, a study on the floral diversity of infested river banks highlighted a decrease in diversity as a function of the density of *A. trifida* (Figure 15) (Washitani, 2001).

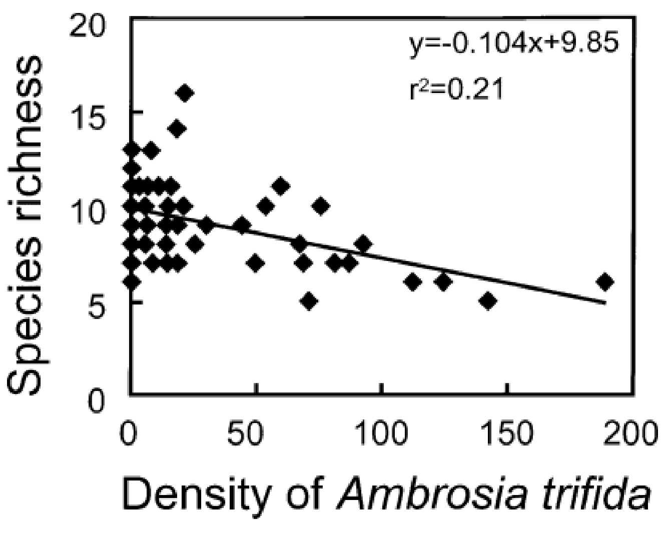

Fig. 4. Relationship between species richness (*y* axis) and the density of *Ambrosia trifida* (*x* axis) in the Tajimagahara Nature Reserve. Species richness and density are defined, respectively, as the number of vascular plant species and the number of mature individuals of *A. trifida* in each quadrat of 0.25 m^2. The regression line and the coefficient of determination are shown (Redrawn from Miyawaki and Washitani 1996)

Figure 15 – Change in species richness as a function of the density of *A. trifida* (Washitani, 2001)

6.08.0A Based on the elements explained in the note, do you consider that the question on the environmental impact caused by the pest within its current area of invasion can be answered?

If yes: Go to point 6.08.01 (see Appendix 3)
If no, but information is available for the native area of the plant, go to point 6.08.01 (see Appendix 3).
If no: answer N/A for 6.08 and go to point 6.09.0C.

No
There is a known population situation in the natural environment in the PRA area. It is a river bank in Italy for which the Working Group has photos of a population of *A. trifida* (Figures 16 and 17). Currently in France, it has only been observed in cultivated environments, with the exception of reports by the Botanical Conservatory of Midi-Pyrénées of populations present in a gravel pit in the region (personal communication J. Dao). To date, no studies have been carried out and there are no results to help determine its environmental impact.

Figure 16 and Figure 17 – *A. trifida* in Italy (Pavia) in a site along the Po (August 2015). The person in the photograph is 1.75 m tall (photo by Peter Toth).

6.09.0C If the assessor considered that Q6.08 could not be answered, i.e. the species has not invaded any other area, or if the invasion is too recent and too little is known on its ecology in the invaded areas, and assuming that no additional investigations can be undertaken during the time available for producing the PRA, an environmental impact assessment cannot be properly made using this scheme.

In light of the two situations mentioned in the PRA area, knowledge acquired in its area of origin, the size of the individuals and the densities of the known populations, the members of the Working Group are concerned that the environmental impact of this species in meso-hygroscopic environments (river banks, wet grasslands, gravel pits and ditches) could damage local biodiversity.

2.2.2.4.3 Social impact

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

minimal, minor, moderate, major, massive

Level of uncertainty:	**Low**	**Medium**	**High**

From a public health point of view, in the United States, *A. trifida* has been identified as a problem since the 1930s, due to its allergenic pollen and its presence in urban areas. Historically, Gahn (1933) had already indicated that hundreds of thousands of people were affected by allergy problems without any quantified costs being mentioned. Today, the allergens are known (Golstein *et al*., 1994) and the health effect remains significant to such a point that visitor numbers at certain tourist sites are affected according to the presence of species of the genus *Ambrosia*. In the United States, some areas are formally characterised by their absence of species of the genus *Ambrosia* with regard to the population and tourism (http://www.ragweedfreevacations.com/).
The importance of the social damage caused by *A. trifida* is therefore considered to be major.

Level of uncertainty: Low

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

minimal, minor, moderate, major, massive

Level of uncertainty:	**Low**	**Medium**	**High**

Given the known social damage in the United States, particularly concerning pollen-related allergies from *A. trifida*, there is a major likelihood of the development of populations of this species in the PRA area resulting in similar social damage (Follak *et al.*, 2013).
There is no doubt about the allergic risk associated with this species. However, the probability of establishment of the species in the entire PRA area has a medium level of uncertainty, which leads us to consider the importance of the social damage as also having medium uncertainty.

Level of uncertainty: Medium

2.2.2.4.4 Other economic impacts

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

Minimal extent, minor extent, moderate extent, major extent, massive extent

Level of uncertainty:	**Low**	**Medium**	**High**

Not applicable

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

minimal, minor, moderate, major, very high

Level of uncertainty:	**Low**	**Medium**	**High**

Not applicable

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, minor, moderate, major, very high

Level of uncertainty:	**Low**	**Medium**	**High**

Not applicable

2.2.2.4.5 Conclusion of the assessment of economic consequences

6.15 With reference to the area of potential establishment identified in Q 3.08, identify the areas which are at highest risk of economic, environmental and social impacts. Summarise the impacts and indicate how these may change in future.

Minimal, minor, moderate, major, massive

Level of uncertainty:	**Low**	**Medium**	**High**

The areas most at risk in the PRA region include France (in the south-west, the valleys of the Rhône, the Saône and the Rhine), Spain (north-east), northern Italy (mainly the plain of the Po), very locally in Switzerland, southern Germany, southern Poland, the southern Czech Republic and Slovakia, eastern Austria, Hungary, northern Slovenia, Croatia, Bulgaria and Romania. In these areas, the impacts currently concern decreases in yield and increased control costs in summer crops in south-west France (and in the plain of the Po in Italy).
The risk of development of ALS inhibitor-resistant populations raises concerns about major management difficulties.
The extension of the species in the risk area could in future increase the risk of pollen allergies and the associated health costs.
Lastly, its possible presence in natural environments (river banks, wet grasslands) suggests potential environmental impacts.

Level of uncertainty: Low

2.2.3 Conclusion of the pest risk assessment

Entry

The contamination of seed lots or of maize, soybean or sunflower seed for livestock feed or the agri-food industry, imported from the area of origin of *A. trifida* into the PRA area, is regarded as the main factor for the introduction of this species. In addition, the volumes involved have been consistently high over the past few years. These imports are not covered by any particular regulations or controls with regard to their potential contamination by seeds of *A*. *trifida*. The regular entry of seeds of *A*. *trifida* in different localities in the PRA area therefore seems likely.

Establishment

The establishment of *A*. *trifida* in the PRA area appears likely in all regions with warm and humid summers, especially in and on the edge of agricultural fields planted with maize, soybeans, sunflower or sorghum. In addition, the species can easily become established alongside water courses. Many of the countries of the European Union could therefore see the establishment of *A. trifida* in meso-hygrophilic environments, from south-west France, north-east Spain and northern Italy through to southern Germany and Poland and a large part of central Europe and the Balkans. The southernmost countries have summers that are too dry while the summers in the countries further north are not hot enough. Inside the PRA area, large populations are presently only observed in the plain of the Po River and in south-west France.

Spread

The natural spread of *A*. *trifida* is slow and limited in distance, except in the case of hydrochory along a water course. However, the risk of long-distance spread by the transport of contaminated soil, crops and especially agricultural equipment used for harvesting infested crops seems very high. The risk of this species spreading from an infested site therefore seems very likely.

Economic importance

From an agricultural point of view, the impact on contaminated plots is very rapid and can result in the total loss of the harvest and additional management costs for the plot. From a social and public health perspective, *A. trifida* contributes to the presence in the atmosphere of allergenic pollen that will only aggravate the issue of pollen-related allergies. This issue affects both the local population and the ability to attract tourism. The probability and magnitude of these impacts within the PRA area will depend on the species' ability to become established in the coming years, according to the different ecoclimatic areas identified as favourable to its development.

Overall conclusion of the pest risk assessment

Considering the different hazards and risks posed by *A. trifida* for the PRA area, the current low level of the invasion and the difficulties in terms of curative management of this species in the current context, the Working Group considers that the pest risk is unacceptable. The major points leading to this conclusion are as follows:

- An introduction by the pathway from the area of origin that is difficult to control,
- The broad distribution of favourable ecoclimatic areas across the entire PRA area,
- Crop systems conducive to its development, mainly due to the limited effectiveness of chemical and mechanical weed control practices against this species,
- Great difficulties with control in non-agricultural environments,
- The allergic nature of the pollen from this species.

2.3 Stage 3: Pest risk management

2.3.1 Acceptability of the risk

7.01 Is the risk identified in the Pest Risk Assessment stage for all pest/pathway combinations an acceptable risk?
If yes STOP
If no Proceed through the risk management scheme following the instructions below

No.

7.02 Is natural spread one of the pathways (see answer to question 2.01)?

If yes **Go to point 7.03**
If no **Go to point 7.06**

No,
There are currently no available data indicating natural spread from the area of origin to the PRA area.

7.06 Is the pathway that is being considered a commodity of plants and plant products?

If yes **Go to point 7.09**
If no **Go to point 7.07**

Yes,

It is a plant product. It concerns seed from summer crops (soybean, maize, sorghum and sunflower) coming from the area of origin.

2.3.2 Existing phytosanitary measures

If the pest is a plant, is it the commodity itself?

If yes **Go to point 7.30**
If no (the pest is not a plant or the pest is a plant but is not the commodity itself) **Go to point 7.10**

7.10 Are there any existing phytosanitary measures applied on the pathway that could prevent the introduction of the pest?

If yes **If appropriate, list the measures and identify their efficacy against the pest of concern and go to point 7.11**
If no **Go to point 7.13**

Level of uncertainty:	**Low**	**Medium**	**High**

No

There are currently no European regulations concerning a specific purity requirement for seed lots introduced into the PRA area with respect to *A. trifida*. In contrast, for the introduction of grain intended for bird food, there is a regulation imposing a threshold of 50 mg.kg^{-1} for seeds of the genus *Ambrosia* (Regulation (EU) 2015/186).

Level of uncertainty: Low

2.3.3 Identification of appropriate risk management options

2.3.3.1 Options at the place of production

2.3.3.1.1 Detection of the pest at the place of production by inspection or testing

7.13 Can the pest be reliably detected by visual inspection at the place of production?

If yes or could be considered in a Systems Approach **possible measure: visual inspection at the place of production**

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

Yes,
The pest can be reliably detected by visual inspection at the place of production, at least during the growing period.

Level of uncertainty: Low
The risk of confusion with other weed species is very limited.

7.14 Can the pest be reliably detected by testing at the place of production?

If yes or could be considered in a Systems Approach **possible measure: specified testing at the place of production**

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

Not applicable
Recognition of *A. trifida* at the vegetative stage or the seed state can be achieved visually without any ambiguity and requires no additional testing.

2.3.3.2 Prevention of infestation of the commodity at the place of production

7.15 Can infestation of the commodity be reliably prevented by treatment of the crop?

If yes or could be considered in a Systems Approach — **possible measure: specified treatment of the crop**

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

Yes

At the plot scale, it is technically possible to achieve total control of *A. trifida* by a combination of chemical and mechanical weed control and agronomic practices. Currently, the development of resistance to herbicides, particularly to ALS-inhibitors and glyphosate, is reducing the effectiveness of control (Heap, 2017). Moreover, supplementary mechanical management is not really feasible on a large scale.

At the regional scale, it is likely that the infestation cannot be reliably prevented, as shown by the progression of *A. trifida* on the North American continent (Royer and Dickinson 1999).

Level of uncertainty: Medium

7.16 Can infestation of the commodity be reliably prevented by growing resistant cultivars?

If yes or could be considered in a Systems Approach — **possible measure: consignment should be composed of specified cultivars**

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

Not applicable

7.17 Can infestation of the commodity be reliably prevented by growing the crop in specified conditions?

If yes or could be considered in a Systems Approach — **possible measure: specified growing conditions of the crop**

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

Not applicable

7.18 Can infestation of the commodity be reliably prevented by harvesting only at certain times of the year, at specific crop ages or growth stages?

If yes or could be considered in a Systems Approach — **possible measure: specified age of plant, growth stage or time of year of harvest**

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

No

The crops concerned (production of maize, sorghum and soybean seed) cannot be harvested outside the fruiting period of *A. trifida*.

Level of uncertainty: Low

7.19 Can infestation of the commodity be reliably prevented by production in a certification scheme (i.e. official scheme for the production of healthy plants for planting)?

If yes or could be considered in a Systems Approach — **possible measure: certification scheme**

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

Infestation of the commodity can indeed be prevented through a certification scheme (plots free of *A. trifida*).

Level of uncertainty: Low

7.20 Based on your answer to question 4.01, select the possible measures based on the capacity for natural spread.

Very low rate of natural spread	**pest freedom of the crop, or pest-free place of production or pest-free area**
Low to moderate rate of natural spread	**pest-free place of production or pest-free area**
High to very high rate of natural spread	**pest-free area**

Level of uncertainty:	**Low**	**Medium**	**High**

The natural dispersal ability of *A. trifida* is very low. It can be assumed that the absence of *A. trifida* from a cultivated field can prevent infestation of the commodity.
A guaranteed absence of *A. trifida* from the production area would help avoid any post-harvest contamination of the commodity during its storage.

Level of uncertainty: Low

7.21 Can pest freedom of the crop, place of production or an area be reliably guaranteed?

If no	**Possible measure identified in question 7.20 would not be suitable**

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

Yes
The absence of *A. trifida* from a crop can be reliably guaranteed.
A visual observation during the growing period and before the harvest (July – August) can guarantee the absence of *A. trifida*. However, it is important to ensure that the harvesting and transport machinery was not previously used in areas infested by *A. trifida* or that it has been cleaned according to conventional procedures.

Level of uncertainty: Low

7.22 Can the pest be reliably detected by a visual inspection of a consignment at the time of export, during transport/storage?

If yes or could be considered in a Systems Approach		**possible measure: visual inspection of the consignment**	
Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

Yes
A visual inspection can enable detection of seeds of *A. trifida* in a seed lot.

Level of uncertainty: Low

7.23 Can the pest be reliably detected by testing of the commodity (e.g. for a pest plant, seeds in a consignment)?

If yes or could be considered in a Systems Approach		**possible measure: specified testing of the consignment**	
Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

Not applicable

7.24 Can the pest be effectively destroyed in the consignment by treatment (chemical, thermal, irradiation, physical)?

If yes or could be considered in a Systems Approach		**possible measure: specified treatment**	
Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

Yes
Mechanical screening of seeds can help remove *A. trifida* seeds, but it is not totally reliable given the large variability in size and weight of *A. trifida* seeds, which makes it difficult to separate them from maize and soybean seeds, which are however fairly heavy (1000 grains weigh respectively around 165 and 330 grams – source Arvalis; Institut du végétal).

Level of uncertainty: Medium

7.25 Does the pest occur only on certain parts of the plant or plant products (e.g. bark, flowers), which can be removed without reducing the value of the consignment?

If yes		**possible measure: removal of parts of plants from the consignment**	
Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

Not applicable

7.26 Can infestation of the consignment be reliably prevented by handling and packing methods?

If yes or could be considered in a Systems Approach **possible measure: specific handling/packing methods of the consignment**

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

Yes

Infestation of the consignment can be prevented by storage and transport in containers free of any contamination.

Level of uncertainty: Low

7.27 Can the pest be reliably detected during post-entry quarantine?

If yes **possible measure: import of the consignment under special licence/permit and post-entry quarantine**

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

Yes

The pest can be reliably detected during post-entry quarantine. However, the degree of accuracy of this detection will depend on the sampling protocol for the seed lot. The total absence of the species is difficult to guarantee.

Level of uncertainty: Medium

7.28 Could consignments that may be infested be accepted without risk for certain end uses, limited distribution in the PRA area, or limited periods of entry, and can such limitations be applied in practice?

If yes **possible measure: import under special licence/permit and specified restrictions**

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

No

Accepting infested seed lots subject to them being used for consumption or the agri-food industry might appear to be a solution. However, this solution is unacceptable for the following reasons:

- Even if a seed lot is sent directly to the agri-food sector, transport and storage represent a risk of development of individuals. If these individuals carry resistance to herbicides, the spread of resistance genes cannot be ruled out,
- If this grain is intended for animal feed, up to 50 g of seeds (i.e. between 575 and 1163 seeds (Schutte *et al.*, 2008)) of *A. trifida* could potentially be introduced per tonne of commodity in compliance with Regulation (EU) 2015/186,
- Even grain intended for feed is sometimes used as seeds for planting and can be a source of contamination of plots. For example, in the Gers *département* in the Occitanie region of France, an infestation of *A. trifida* was noted in fields free of this species, following the planting of organic soybean seeds initially intended for consumption (personal communication N. Benat),
- Lastly, it is very important not to introduce individuals that are resistant to different herbicides.

Level of uncertainty: Medium

There is uncertainty regarding the probability of installation of populations from seed lots intended for feed or agri-food processing and regarding the flow of genes to other populations. Nevertheless, the spread of any resistance that has not yet been observed within the PRA area would have major negative consequences and the risk cannot be accepted.

7.29 Are there effective actions that could be taken in the importing country (surveillance, eradication, containment) to prevent establishment and/or economic or other impacts?

If yes	**Possible measures: internal surveillance and/or eradication or containment campaign**

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

Yes

There are effective measures that can be taken in the importing country to prevent the entry, establishment and economic impact of already-existing populations:

- Using seed certified free from *A. trifida* seeds,
- Monitoring the emergence and development of populations of *A. trifida* (observation, mapping and reporting),
- Implementing early eradication of newly-established populations (chemical or mechanical),
- Implementing management and/or eradication of already-established populations (chemical or mechanical, implementation of appropriate agronomic practices). Different *A. trifida* control methods were assessed in the United States, in open-field tests in 2013 and 2014. On maize, ploughing before planting led to control of 80-85% compared to the absence of ploughing. Ploughing followed by a pre-emergence treatment with saflufenacil plus dimethenamid-P, with or without atrazine, enabled control of 99%, compared with 86-96% for pre-emergence application of herbicides alone, respectively 7 and 21 days after application. There were still 4 to 14 *A. trifida* per m^2 after ploughing (alone) or a post-emergence herbicide treatment (alone), and fewer than 3 *A. trifida* per m^2 after a pre-emergence and post-emergence programme. The maize yield was higher in the case of the ploughing followed by pre- and post-emergence herbicide treatments. The authors concluded that the combination of ploughing and pre- and post-emergence herbicide treatments decreases the density and accumulation of biomass of *A. trifida* at the beginning of the season, and constitutes an integrated approach for effective management of the species (Ganie *et al.*, 2017),
- Action to prevent anthropogenic spread from already-established populations (cleaning of agricultural machinery, limiting the movement of agricultural equipment outside infested zones, limiting soil transport from infested areas, etc.).

The effectiveness of these various measures lies in their combined and complementary implementation.

Level of uncertainty: Low

2.3.4 Evaluation of risk management options

7.30 Have any measures been identified during the present analysis that will reduce the risk of introduction of the pest? List them.

If yes **Go to next question**
If no **Go to point 7.37**

Yes
The risk of introduction primarily stems from the pathways for the introduction of seed (maize, soybean, sunflower and sorghum) and to a lesser extent from the pathways for the introduction of grain for animal feed.

The measures that will reduce the risk of introduction are:
- Certification of seed purity regardless of its origin (area of origin, PRA area or other),
- Inspection of seed when it enters the PRA area, at least for soybean, maize, sorghum and sunflower,
- The requirement to use seed certified free of *A. trifida*,
- Strict application of Regulation (EU) 2015/186 for controls of grain intended for animal feed.

7.31 Does each of the individual measures identified reduce the risk to an acceptable level?

If yes **Go to point 7.34**
If no **Go to next question**

Level of uncertainty:	**Low**	**Medium**	**High**

No
See question 7.32.

Level of uncertainty: Low

7.32 For those measures that do not reduce the risk to an acceptable level, can two or more measures be combined to reduce the risk to an acceptable level?

If yes **Go to point 7.34**
If no **Go to next question**

Level of uncertainty:	**Low**	**Medium**	**High**

Yes
Combining the four measures set out in point 7.30 should make it possible to reduce the risk of introduction to an acceptable level.
Moreover, in order to prevent spread within the PRA area, the various measures set out in 7.29 should be implemented in combination.

Level of uncertainty: Low

7.34 Estimate to what extent the measures (or combination of measures) being considered interfere with international trade.

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

Seed certification may lead to an additional production cost, which could significantly affect the volumes of seed from the sectors concerned traded at the international level.
For grain intended for animal feed, there are already regulations.

Level of uncertainty: Medium
It is difficult to estimate the increased sale cost of seeds following their certification.

7.35 Estimate to what extent the measures (or combination of measures) being considered are cost-effective, or have undesirable social or environmental consequences.

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

The requirement to use certified seed could conflict with the use of farm-saved seed for some crops.
The avoidance of summer crops favourable to the development of *A. trifida* in the rotation in areas already infested by this species could have an economic impact on the operating account.

Level of uncertainty: high

7.36 Have measures (or combination of measures) been identified that reduce the risk for this pathway, and do not unduly interfere with international trade, are cost-effective and have no undesirable social or environmental consequences?

If yes — **For pathway-initiated analysis, go to point 7.39**
For pest-initiated analysis, go to point 7.38
If no — **Go to next question**

Yes
The measures identified reduce the risk for this pathway without unduly interfering with international trade. While the measures undoubtedly have a cost, their cost-effectiveness seems favourable due to the pest potential and harmfulness of the species. However, a precise assessment of this relationship, and of the environmental and societal consequences, is very difficult based on current knowledge. In addition, this type of work never seems to have been performed for a plant pest. Reducing the number of plants in the agricultural environment will limit the spread of *A. trifida* to damp environments where control is only possible with significant environmental (application of plant protection products, mowing and tillage) or economic (manual grubbing-up) consequences, for example.

7.38 Have all major pathways been analysed (for a pest-initiated analysis)?

If yes — **Go to point 7.41**
If no — **Analyse the next major pathway**

Yes
A single pathway has been identified.

7.41 Consider the relative importance of the pathways identified in the conclusion to the entry section of the pest risk assessment.

Go to next question

Not applicable

7.42 All the measures or combination of measures identified as being appropriate for each pathway or for the commodity can be considered for inclusion in phytosanitary regulations in order to offer a choice of different measures to trading partners. Data requirements for surveillance and monitoring to be provided by the exporting country should be specified.

Go to next question

The least stringent measures for preventing the introduction and spread of *A. trifida* are as follows:

- Verifying the total absence of *A. trifida* seeds in seed lots when they enter the PRA area, at least for soybean, maize, sorghum and sunflower,
- Widespread use of seed guaranteed free from *A. trifida* seeds in the PRA area. This measure may require the establishment of a certification system in the seed production sector,
- Monitoring the emergence and development of new populations of *A. trifida* (observation, mapping and reporting); the surveillance system should include a campaign to raise awareness among the various players in the field,
- Implementing early eradication measures for newly-reported populations (chemical or mechanical),
- Implementing a containment or eradication plan for already-established populations (chemical or mechanical, implementation of appropriate agronomic practices).

7.43 In addition to the measure(s) selected to be applied by the exporting country, a phytosanitary certificate (PC) may be required for certain commodities. The PC is an attestation by the exporting country that the requirements of the importing country have been fulfilled. In certain circumstances, an additional declaration on the PC may be needed (see EPPO standard PM 1/1(2) *Use of phytosanitary certificates*).

Go to next question

The phytosanitary certificate should mention the absence of seeds of *A. trifida* in seed lots of soybean, maize, sunflower and sorghum. Only the absence of *A. trifida* in the production and packaging area can achieve this objective (total absence in the field and its environment and strict control in the transport and packaging sector).

7.44 If there are no measures that reduce the risk for a pathway, or if the only effective measures unduly interfere with international trade, are not cost-effective or have undesirable social or environmental consequences, the conclusion of the pest risk management stage may be that introduction cannot be prevented. In the case of a pest with a high natural spread capacity, regional communication and collaboration is important.

Not applicable

2.3.5 Conclusion of pest risk management

Summarise the conclusions of the pest risk management stage. List all potential management options and indicate their effectiveness. Uncertainties should be identified.

Measure	**Effectiveness**	**Uncertainty**
Monitoring the total absence of *A. trifida* seeds in seed lots on entering the PRA area	Very high to avoid any new introduction	Low, but depends on the diversity of enforcement of controls in the PRA area
Widespread use of seed guaranteed free from *A. trifida* seeds in the PRA area	Very high to avoid any new introduction	Low, if farmers comply with the measure
Monitoring the emergence and development of new populations of *A. trifida*	High because of the high detectability of the plant	Medium, because it depends on the establishment of a structured surveillance system
Implementing early eradication measures for newly-reported populations	Very high in agricultural environments, medium in natural or semi-natural environments	Low in agricultural environments because easily applicable, medium in natural and semi-natural environments because it depends on the effectiveness of the decision-making and operational structure
Implementing a containment or eradication plan for already-established populations	Medium in agricultural environments, low in natural and semi-natural environments	Medium in agricultural environments because easily applicable, high in natural and semi-natural environments because it depends on the effectiveness of the decision-making and operational structure

Date of validation of the collective expert appraisal report by the Working Group and the Expert Committee: 8 June 2017

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ANNEXES

Annex 1: Formal request letter

2016 -SA- 0090

COURRIER ARRIVE

25 AVR. 2016

21 MARS 2016

DIRECTION GENERALE

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

MINISTERE DES AFFAIRES SOCIALES ET DE LA SANTE	MINISTERE DE L'ENVIRONNEMENT, DE L'ENERGIE ET DE LA MER	MINISTERE DE L'AGRICULTURE, DE L'AGROALIMENTAIRE ET DE LA FORET
Direction générale de la santé	**Direction générale de l'aménagement, du logement et de la nature**	**Direction générale de l'alimentation**

N°32

Paris, le 19 FEV. 2016

Le Directeur général de la santé

Le Directeur général de l'aménagement, du logement et de la nature

Le Directeur général de l'alimentation

à

Monsieur le Directeur général de l'Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail (ANSES)
27-31 avenue du Général Leclerc
94701 Maisons-Alfort cedex

Objet : **Saisine pour la réalisation d'une analyse de risques relative à l'ambroisie trifide (*Ambrosia trifida* L.) et pour l'élaboration de recommandations de gestion**

P.J. : Fiche d'alerte de l'ANSES, du 22/10/2013, sur l'extension localisée mais rapide d'une plante envahissante à impact potentiel sur la santé humaine : *Ambrosia trifidia*

Le 22 octobre 2014, le Parlement européen et le Conseil ont publié un règlement relatif à la prévention et à la gestion de l'introduction et de la propagation des espèces exotiques envahissantes (EEE)[1]. Ce règlement prévoit, en particulier à son article 19, que les États membres mettent en place des mesures efficaces de gestion vis-à-vis d'une liste d'EEE dites préoccupantes pour l'Union qui, selon l'article 4, doit être adoptée, par voie d'actes d'exécution, par la Commission européenne début 2016. Cette liste sera régulièrement révisée. Ainsi l'inscription d'une espèce dans cette liste se traduira par la mise en place d'actions de prévention et de lutte coordonnées entre les différents Etats-membres de l'Union européenne, visant à réduire les impacts négatifs de ces espèces en premier lieu sur la biodiversité et les services écosystémiques ainsi que d'autres impacts négatifs éventuels dans le cas de certaines EEE pouvant entraîner des impacts sur la santé humaine et/ou des impacts économiques.

Pour toutes les espèces qui seront proposées pour la future liste susmentionnée, la Commission européenne doit disposer d'une analyse de risques respectant 14 normes qu'elle a fixées dans le rapport « Invasive alien species – framework for the identification of invasive alien species of EU concern. ENV.B.2/ETU/2013/0026 »[2], ainsi que 5 critères définis à l'article 4 du règlement. Pour un certain nombre d'espèces listées dans le rapport suscité, des analyses de risques sont déjà disponibles. Pour celles n'y figurant pas et qu'un Etat-membre souhaiterait voir

[1] Cf. http://eur-lex.europa.eu/legal-content/FR/TXT/PDF/?uri=OJ:JOL_2014_317_R_0003
[2] Cf. http://ec.europa.eu/environment/nature/invasivealien/docs/Final%20report_12092014.pdf

2016 -SA- 0 0 9 0

proposer dans le cadre de la révision régulière de la liste (cf. Article 4), une analyse de risque est à fournir à la Commission européenne.

Parmi les espèces végétales du genre *Ambrosia* présentes en France, plusieurs constituent des espèces exotiques envahissantes à impact potentiel pour la santé puisqu'elles émettent un pollen hautement allergisant pour l'homme. C'est le cas en particulier de l'ambroisie à feuilles d'armoise (*Ambrosia artemisiifolia* L.), de l'ambroisie trifide (*Ambrosia trifida* L.) et de l'ambroisie à épis lisses (*Ambrosia psilostachya* DC.). Si pour l'ambroisie à feuilles d'armoise (*Ambrosia artemisiifolia* L.), une analyse de risques est disponible dans le rapport susmentionné, tel n'est pas le cas pour l'ambroisie trifide.

L'ambroisie trifide est également une adventice des cultures des plus difficiles à gérer dans sa zone d'origine, sa taille et son cycle de végétation induisant un concurrence forte avec la végétation en place. Elle a fait l'objet d'une fiche d'alerte de l'ANSES en 2013 et les observations confirment son implantation en Midi-Pyrénées, sur des périmètres permettant encore d'envisager son contrôle.

Par ailleurs, cette espèce est visée par plusieurs actions du 3ème plan national santé-environnement (PNSE 3), en particulier l'action n°11 visant à mieux évaluer l'exposition à l'ambroisie et surveiller son expansion géographique, et l'action n°12 qui a notamment pour objectif de renforcer et de coordonner la gestion des espèces végétales et animales dont la prolifération peut être nuisible à la santé publique.

Dans ce contexte et afin de pouvoir proposer également cette ambroisie lors d'une prochaine révision de la liste européenne susmentionnée, nous vous saisissons pour la réalisation d'une analyse de risques concernant cette espèce et en considérant comme aire géographique l'ensemble du territoire de l'Union européenne. Cette analyse de risques comprendra à la fois un volet évaluation des risques incluant les impacts sur la santé humaine et les effets du changement climatique dans un avenir prévisible, et un volet gestion des risques, en suivant la méthodologie préconisée par la Commission européenne dans le cadre du règlement européen susmentionné. Afin de mettre en œuvre l'action n°12 du PNSE 3, votre expertise fournira également des recommandations visant à renforcer la gestion de cette espèce en France et améliorer la coordination des actions de gestion déjà mises en œuvre sur notre territoire.

Vous associerez notamment à vos travaux l'Institut national de la recherche agronomique (Inra) et l'Observatoire des ambroisies, ainsi que les autres partenaires nationaux et les partenaires internationaux travaillant dans ce domaine.

Nous vous remercions de bien vouloir nous transmettre, dans les meilleurs délais, votre proposition de contrat d'expertise comprenant notamment les modalités de traitement et de restitution des travaux, dont le rendu final est attendu pour juin 2016.

Le Directeur général de la santé	Le Directeur général de l'aménagement, du logement et de la nature	Le Directeur général de l'alimentation
Pr. Benoît VALLET	Paul DELDUC	Patrick DEHAUMONT

<u>Copie</u> : Inra, Observatoire des ambroisies, Fédération des conservatoires botaniques nationaux (FCBN), Muséum national d'histoire naturelle (MNHM).

Annex 2: Analysis of the potential distribution of *Ambrosia trifida* in Europe (Jean-Pierre Rossi)

Distribution géographique d'*Ambrosia trifida* en Europe

Jean-Pierre Rossi
CBGP - INRA Montpellier

2017-05-14

Contents

1 Objectifs

- Estimer la niche réalisée d'*Ambrosia trifida*
- Identifier les variables climatiques expliquant le patron observé
- Ajuster un modèle d'aire de distribution et en évaluer les performances
- Estimer l'aire de distribution potentielle d'*Ambrosia trifida* en Europe

2 Méthode

2.1 Données utilisées

2.1.1 Données d'occurrence

Les données d'occurrence disponibles proviennent de diverses sources bibliographiques et de la base de données GBIF (http://www.gbif.org/). Ces données ont été assemblées et vérifiées par Bruno Chauvel (INRA Dijon), Guillaume Fried (ANSES - Montpellier) et les experts impliqués dans l'analyse (Figure 1).

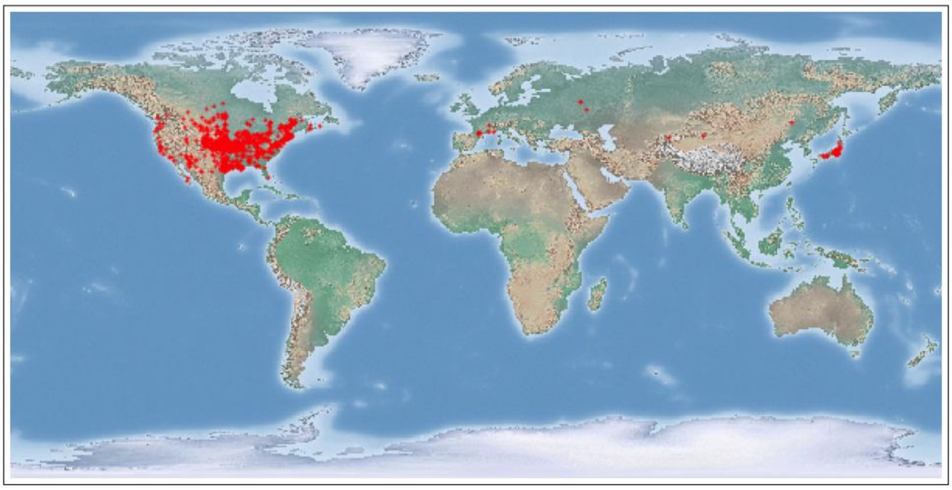

Figure 1: Distribution géographique des occurences de l'espèce *Ambrosia trifida* utilisées dans l'analyse.

Le jeu de données a été retravaillé afin d'éliminer les points situés dans un même pixel des cartes de données bioclimatiques (voir ci-dessous) afin de ne pas dupliquer l'information de façon artificielle (declustering) (Kramer-Schadt et al. 2013). Le jeu de données ainsi obtenu regroupe 1252 occurrences réparties aux USA, en Europe et au Japon (Figure 1). La couverture géographique reste inchangée.

2.1.2 Données bioclimatiques

Les modèles d'aire de distribution ont été construits à partir des données bioclimatiques contenues dans la base de données worldclim (http://www.worldclim.org/) (Hijmans et al. 2005) qui est très largement utilisée dans le domaine de la modélisation de niches écologiques. Plusieurs modèles ont été construits avec tout ou avec un sous-ensemble de ces variables. Les résultats ont été discutés au cours des différentes réunions du comité d'experts chargé de l'analye du risque phytosanitaire pour l'espèce *A. trifida*.

Sur les 19 variables disponibles (Tableau 1) nous avons finalement retenu les variables BIO2 [Mean Diurnal Range (Mean of monthly (max temp - min temp))], BIO10 (Mean Temperature of Warmest Quarter) et BIO18 (Precipitation of Warmest Quarter) qui sont pertinentes du point de vue écologique (bonne représentativité des contraintes s'exerçant sur la plante). Il est important de limiter le nombre de variables explicatives pour conserver une bonne transférabilité (Franklin 2009). Les données exploitées correspondent à l'intervalle de temps compris en 1960 et 1990 et leur résolution est de 30 secondes (0.86 km^2 à l'équateur).

Table 1: Tableau des variables bioclimatiques disponibles dans la base de données worldclim (Hijmans et al. 2005).

abbréviation	variable bioclimatique
BIO1	Annual Mean Temperature
BIO2	Mean Diurnal Range (Mean of monthly (max temp - min temp))
BIO3	Isothermality (BIO2/BIO7) (* 100)
BIO4	Temperature Seasonality (standard deviation *100)
BIO5	Max Temperature of Warmest Month
BIO6	Min Temperature of Coldest Month
BIO7	Temperature Annual Range (BIO5-BIO6)
BIO8	Mean Temperature of Wettest Quarter
BIO9	Mean Temperature of Driest Quarter
BIO10	Mean Temperature of Warmest Quarter
BIO11	Mean Temperature of Coldest Quarter
BIO12	Annual Precipitation
BIO13	Precipitation of Wettest Month
BIO14	Precipitation of Driest Month
BIO15	Precipitation Seasonality (Coefficient of Variation)
BIO16	Precipitation of Wettest Quarter
BIO17	Precipitation of Driest Quarter
BIO18	Precipitation of Warmest Quarter
BIO19	Precipitation of Coldest Quarter

2.2 Modèles d'aire de distribution

Nous avons opté pour l'algorithme `MaxEnt` (maximum entropy : Phillips, Anderson, and Schapire 2006). Cette technique permet de travailler des jeux de données contenant uniquement des données de présence. `MaxEnt` a de plus d'excellentes capacités de prédiction (Elith et al. 2011). En choisissant `MaxEnt` nous privilégions la capacité de prédiction par rapport à la capacité d'explication du modèle en terme d'importante écologique des variables climatiques. Ce parti pris traduit notre objectif dans le cadre de l'analyse du risque phytosanitaire qui est avant tout d'estimer l'aire de distribution géographiqe potentielle d'*A. trifida*.

3 Résultats : distribution potentielle

L'AUC du modèle ajusté sur l'ensemble des occurrences prend une valeur de 0.90 ce qui indique un très bon ajustement. La contribution des variables bio 10, bio 18 et bio 2 (voir abbréviations dans le Tableau 1) est respectivement de 56.4%, 36.3% et 7.3%.

La figure 2 représente l'indice d'*habitat suitability* à l'échelle du globe. Cet indice produit par `MaxEnt` peut être vu comme le niveau de similarité entre l'enveloppe climatique des occurrences et les conditions climatiques qui prévalent au niveau de chaque pixels de la carte. La figure 3 montre le détail de la distribution de cet indice pour la zone Europe. La figure 4 représente les zones (en vert) pour lesquelles l'indice d'"habitat suitability" est supérieur au seuil maximisant simultanément la sensibilité et la spécificité du modèle.

Ces résultats indiquent clairement que l'Europe offre des conditions climatiques favorables à l'espèce *A. trifida*.

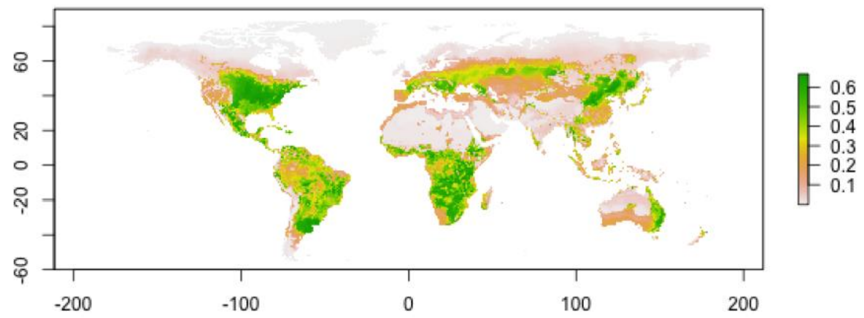

Figure 2: "Habitat suitability" pour *A. trifida* à l'échelle du globe. Plus l'indice est fort et plus les conditions environmentales sont similaires à celles qui règnent dans les zones où l'espèce est présente.

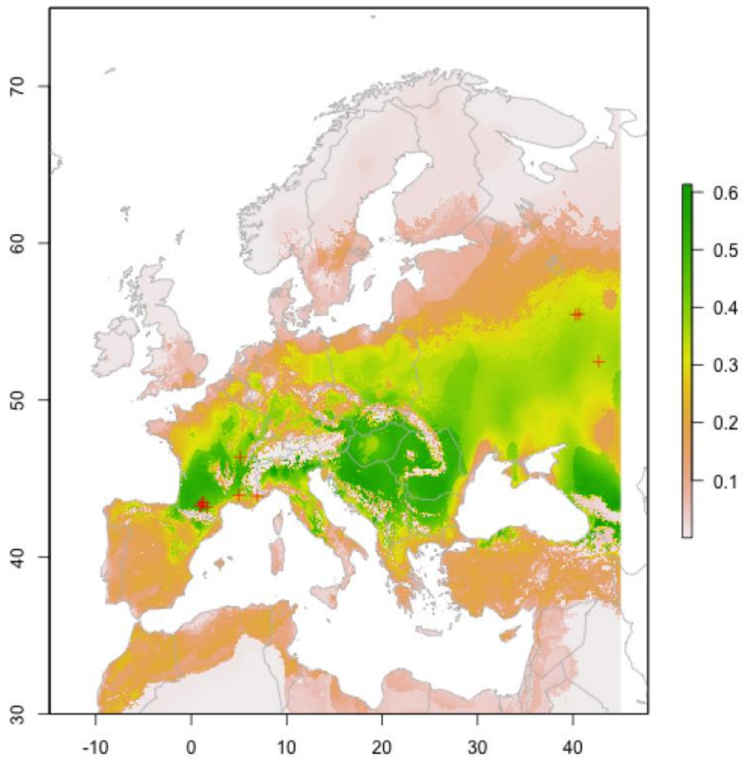

Figure 3: Détail de l'"habitat suitability" pour l'Europe. Les points d'occurrence sont représentés en rouge. Plus l'indice est fort et plus les conditions environmentales sont similaires à celles qui règnent dans les zones où l'espèce est présente.

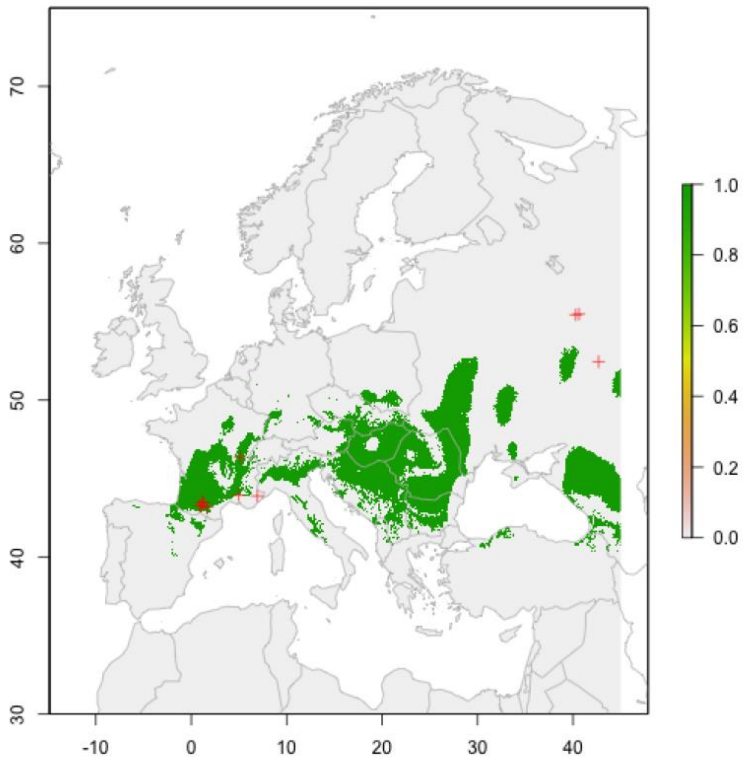

Figure 4: Prédictions du modèle pour l'Europe. Les points d'occurrence sont représentés en rouge. Les zones vertes correspondent à des valeurs de l'"habitat suitability" supérieures au seuil maximisant simultanément la sensibilité et la spécificité du modèle.

4 Conclusions

Les résultats du modèle montrent qu'*A. trifida* rencontre des conditions climatiques favorables en Europe et notamment en France (Figures 3 et 4).

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Annex 3: Tracking of report updates

Date	**Page**	**Description of the change**
07/2017	50	Question 4.02, addition of the following sentence: In France, imports of seed for spring-grown species are not subject to any specific regulations with regard to ragweed. Only the intentional introduction of *Ambrosia artemisiifolia*, *psilostachya* and *trifida* seeds is regulated by the Ministerial Order of 26 April 2017

Notes

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