EPPO Datasheet: *Ambrosia trifida*

Last updated: 2020-09-09

IDENTITY

Preferred name: *Ambrosia trifida*
Authority: Linnaeus
Taxonomic position: Plantae: Magnoliophyta: Angiospermae: Campanulids: Asterales: Asteraceae: Asteroideae
Common names: buffalo weed, crownweed (US), giant ragweed (US), great ragweed, horseweed (US), wild hemp (US)
view more common names online...
EPPO Categorization: A2 list
view more categorizations online...
EPPO Code: AMBTR

more photos...

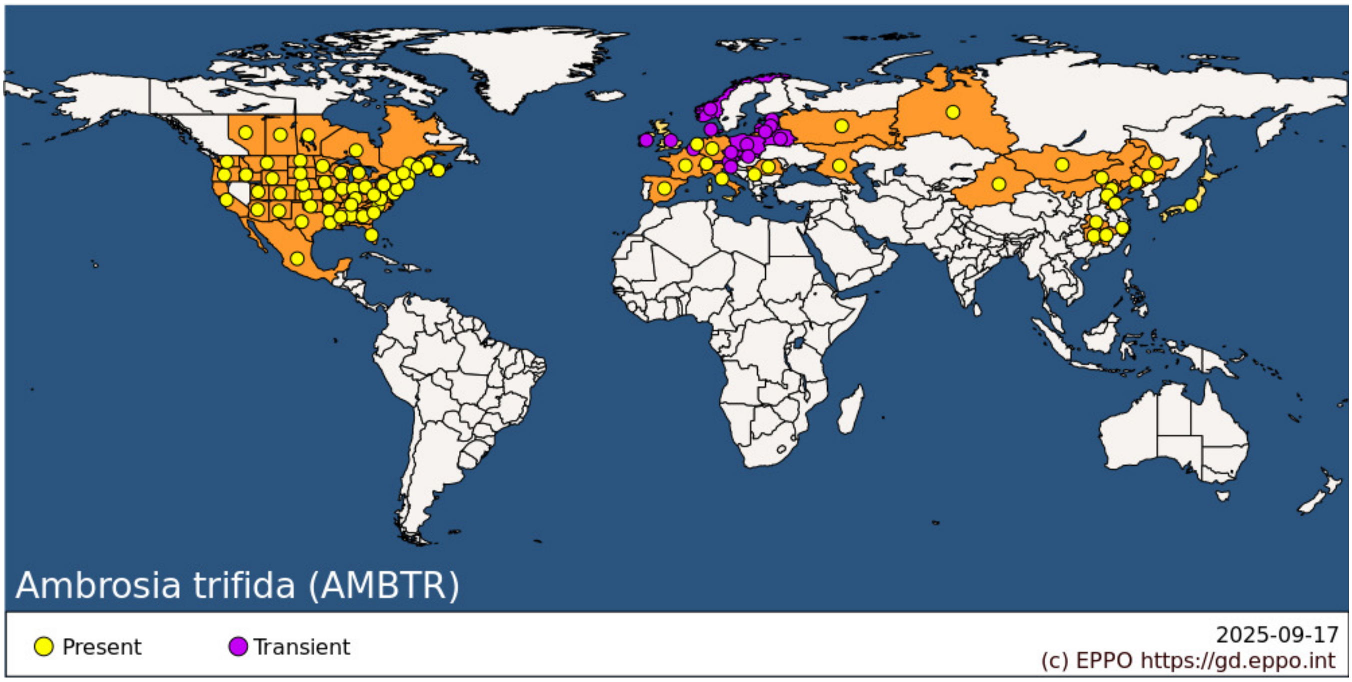
GEOGRAPHICAL DISTRIBUTION

History of introduction and spread

Ambrosia trifida is native to North America where the species is recorded as being weedy in many states (USDA, 2020). In North America, *A. trifida* seems to prefer establishment at latitudes between 45° and 30° north because of fairly strict photoperiodic constraints for flowering, which may maximize its reproduction (Allard, 1943).

Ambrosia trifida was introduced into the EPPO region at the end of the 19th century, and it has expanded its range since the mid-1900s (Moser & Essl, 2013; Chauvel *et al*., 2015). Many of the occurrences of *A. trifida* in the EPPO region are considered casual populations. There are, however, well-established populations in western Europe, with high densities in south-west France (Chauvel *et al*., 2015). It is also considered established in a large part of Italy.

In Japan, the first record was in 1952 from the Shizuoka Prefecture (Honshu) and now *A. trifida* occurs in almost the entire country. In South Korea, *A. trifida* was first recorded in the Seoul metropolitan area during the 1970s and it is now widely naturalized in the country (Kim, 2017). Qin *et al*. (2014) detail that *A. trifida* was introduced into China in 1935 from North America. For China, the literature reports differences in the number of provinces where *A. trifida* occurs, for example Xu *et al*. (2012) list five and Wan *et al*. (2012) lists 12.



EPPO Region: Austria, Belarus, Belgium, Czechia, Denmark, Estonia, France (mainland), Georgia, Germany, Ireland, Italy (mainland), Latvia, Lithuania, Moldova, Republic of, Netherlands, Norway, Poland, Romania, Russian Federation (the) (Central Russia, Southern Russia, Western Siberia), Serbia, Slovakia, Slovenia, Spain (mainland), Switzerland, United Kingdom
Asia: China (Beijing, Hebei, Heilongjiang, Hubei, Hunan, Jiangxi, Jilin, Liaoning, Neimenggu, Shandong, Xinjiang, Zhejiang), Japan, Korea, Republic of, Mongolia
North America: Canada (Alberta, Manitoba, New Brunswick, Nova Scotia, Ontario, Prince Edward Island, Québec, Saskatchewan), Mexico, United States of America (Alabama, Arizona, Arkansas, California, Colorado, Connecticut, Delaware, Florida, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, New Hampshire, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Utah, Vermont, Virginia, Washington, West Virginia, Wisconsin, Wyoming)

MORPHOLOGY

Plant type

Annual herbaceous.

Description

Ambrosia trifida 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). 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). 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 cypsela, tipped with a long central beak surrounded by a crown of approximately five or more shorter tips. It measures from 0.5 to 1.2 cm long and from 0.3 to 0.5 cm wide. *A. trifida* is characterized 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; Hovick *et al*., 2018).

BIOLOGY AND ECOLOGY

General

Ambrosia trifida has a comparatively low fecundity (compared to other *Ambrosia* species), transient seed-bank characteristics and a high percentage of non-viable seeds (Harrison *et al*., 2001, 2007). Goplen *et al*. (2016) detail that plants produced an average of 1800 seeds per plant in soybean and field margins, with 66% being potentially viable. The majority (90% or more) of *A. trifida* seeds buried 10 cm or less lost viability after 4 years (Stoller & Wax, 1974; Harrison *et al*., 2007); however, some seeds remained viable for 9 to 21 years when buried 20 cm or deeper (Toole & Brown, 1946; Harrison *et al*., 2007). Because of their high nutritional value, the seeds are often eaten by animals (e.g. birds and rodents), causing high losses (Harrison *et al*., 2003). It should be noted that *A. trifida* only reproduces by seed and not vegetatively.

Within the EPPO region and the native range, seedlings typically emerge early in the growing season (e.g. March) and over a prolonged period (March until the end of July; Regnier *et al.*, 2016). Flowering occurs in response to shortening day length and begins in the male inflorescences (Allard, 1943). In the native range (North America), *A. trifida* flowers from mid-June to the end of August, or even early September (Bassett & Crompton, 1982). The species can flower 2–3 weeks earlier than *A. artemisiifolia*. In south-west France, the flowering dates observed are similar to those in its area of origin (B. Chauvel, pers. comm., 2019).

Habitats

In North America, *A. trifida* grows in different types of herbaceous communities, including ruderal habitats such as railroad embankments, roadsides and cultivated fields, on rather rich and moist soil (Bassett & Crompton, 1982; Hartnett *et al*., 1987; Krippel & Colling, 2006; Regnier *et al*., 2016). It is also found in damp natural environments, particularly on riverbanks and floodplains as well as managed moist environments such as the banks of irrigation ditches and waterways (Sickels & Simpson, 1985; Regnier *et al*., 2016).

In Japan, *A. trifida* can be found predominantly along riverbanks, mostly in disturbed locations (artificial banks, bridges and quarries) but also in the riverine vegetation (Miyawaki & Washitani, 2004). In South Korea, it occurs in the riparian systems of streams and rivers and around agricultural fields, on road edges and landfill sites and, recently, it has also invaded forest edges and interiors (Lee *et al*., 2010). In Japan and South Korea, *A. trifida* grows also in semi-natural areas (Miyawaki & Washitani, 2004; Lee *et al*., 2010).

Suitable habitats occur for the establishment of *A. trifida* in the EPPO region. It currently 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 (Jehlík & Hejný, 1974), road networks and other disturbed environments (e.g. abandoned industrial sites), as well as green urban areas (gardens; Moser & Essl, 2013).

For *A. trifida*, most natural habitats of high conservation value are unsuitable, and thus negative effects of this plant on biodiversity are considered to be of low importance. Nevertheless, some data are available on A. trifida showing that it is able to invade natural riverside vegetation. There are no data for negative impacts of the species on rivers, especially for where it occurs in the Po Valley (Italy) in the EPPO region. In Central and Eastern Europe, *A. trifida* mainly occupies ruderal habitats including railway tracks and cultivated fields (Rydlo *et al*., 2011). According to Stoyanov *et al*. (2014), *A. trifida* may be established around *Robinia pseudoacacia* bushes close to the railway at the exit of the town of Dalgopol (Bulgaria). In Western Europe (France), the species only occupies cultivated fields.

Environmental requirements

A. trifida is not well adapted to drought, and it is not recorded in areas with a long summer drought unless there is irrigation (Allard, 1943; Regnier *et al*., 2016). Establishment is favoured by moist environments. A. trifida can tolerate a wide variety of soil types (Regnier *et al*., 2016).

Seeds germinate under a wide range of temperatures with an optimum germination between 10 and 24°C (Abul-Fatih & Bazzaz, 1979). The seedlings can develop quickly within 4 to 13 days (Abul-Fatih & Bazzaz, 1979). *A. trifida* can emerge over a long period of time (March to June/July). In France, it emerges together with spring crops or a few days after crop emergence. Soybean is seeded in May in France. In south-west France, germination and emergence can begin as early as the end of March and continue later until the end of summer, especially in irrigated fields (Mamarot & Rodriguez, 2014). *A. trifida* has high photosynthetic ability compared to most annual species (Barnett & Steckel, 2013). It is damaged (i.e. damage to the foliage), but not killed by moderate frost.

In North America, there is variation in *A. trifida* plant traits at both large and small geographic scales. Populations in the western USA corn belt had nearly four times greater fecundity and a 50% greater allocation to reproduction than populations in the eastern USA corn belt (Hovick *et al.*, 2018). In addition, seedling emergence patterns differ among populations in agricultural fields (Sprague *et al*., 2004; Schutte *et al*., 2006, 2008). For example, the latter author showed that seeds which were from Iowa (western USA corn belt) produced seedlings in a rapid flush during early April, whereas seeds from Illinois and Ohio (eastern USA corn belt) produced seedlings in a more gradual flush that extended into late July. Seedling emergence patterns also differ between agricultural and non-agricultural environments. Populations from agricultural habitats exhibited a more prolonged emergence pattern than those from riparian, early successional, railroad siding or forest border habitats (Schutte *et al*., 2012; Hovick *et al*., 2018).

Natural enemies

There are no known natural enemies in the EPPO region.

Uses and benefits

There are no known uses and benefits of *A. trifida* for the EPPO region.

PATHWAYS FOR MOVEMENT

Globally, there have been numerous interceptions of *A. trifida* as a contaminant of seed or as a contaminant of grain (Shamonin & Smetnik, 1986). A. trifida has been introduced in Europe with imports of animal feed and seed. There are documented cases of the introduction of *A. trifida* into the EPPO region (Europe) via seed from crops imported from North America (Moser & Essl, 2013; Chauvel *et al*., 2015). This includes contamination of spring wheat seed for planting (Moser & Essl, 2013), soybean seed (Chauvel *et al*., 2015), maize seed (Stoyanov *et al*., 2014; Chauvel *et al*., 2015; COSAVE, 2019) and seed of other spring crops (sunflower, sorghum; G. Fried, pers. comm., 2019).

IMPACTS

Effects on plants

A. trifida is highly competitive and can form annual monospecific stands in ruderal habitats, forest borders, grassland habitats and riparian habitats (Sickels & Simpson, 1985; Regnier *et al*., 2016).

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 and maize. Even at very low densities (one plant per 25 m2), loss of crop yield (of around 5%) has been shown, a phenomenon rarely observed for other weeds (Harrison *et al*., 2001). Yield reductions of 13–50% have been observed in crop situations, with the losses being greatest when the crop and the weed grow simultaneously (Harrison *et al*., 2001; Barnett & Steckel, 2013). In North America, complete crop losses have been reported due to the presence of *A. trifida* (E. Regnier, pers. comm., 2019).

In 1994, Webster *et al*. (1994) estimated the loss of yield in the USA associated with *A. trifida* in soybeans to be 5–7% of the yield of the crop. A recent study (Regnier *et al*., 2016) among farmers in the USA 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 (ALS) inhibitors or glyphosate (or resistance to both).

In Northeast China, *A. trifida* is considered one of the weeds that causes the most economic damage to wheat and other annual crops. It was found that the plant and its residues have allelopathic effects that reduce wheat growth (Kong *et al*., 2007).

In Europe, it is not currently possible to quantify the economic impacts of this species. In France, in the region of Toulouse, farmers report 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 (A. Rodriguez, pers. comm., 2017). These costs (from a few hundred euros to a few thousand euros per hectare) have not yet been studied to a precise enough degree. At the national level, given the limited distribution of the species and the highly localized nature of the existing populations in the EPPO region (Moser & Essl, 2013; Chauvel *et al*., 2015), the costs in terms of health or losses of agricultural yields attributable to this species are negligible so far.

Any action targeting control of this species will generate additional production costs (cost of weeding practices, establishment of less profitable crops or fallow). In the absence of plant health regulations relating to the control of introduction into the EPPO region 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 USA (Ganie *et al*., 2017).

In 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 European 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 & Gard, 2010). An additional problem is the emerging resistance of *A. trifida* to glyphosate and ALS-inhibiting herbicides (Norsworthy *et al*., 2011; Regnier *et al.*, 2016), thus further decreasing the possible avenues for its control, both in agriculture and ruderal areas, such as railways, roadsides etc.

Based on the results of studies conducted in the USA (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. These results suggest the same level of impact in the PRA area if no control measures are implemented against *A. trifida*.

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. However, until now, no published information has been available to quantify the negative effects of *A. trifida* in the PRA area.

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 prevent their export. As an example, in 2015 the maize export sector from the EU accounted for more than 63 million tonnes (EUROSTAT, 2019). 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*.

Environmental and social impact

For *A. trifida*, most natural habitats of high conservation value have a low potential to be invaded as they have low levels of disturbance, and thus the negative effects of this plant on biodiversity are considered to be of low importance. Nevertheless, some data are available on *A. trifida* showing that it is able to invade natural riverside vegetation. There are no data for negative impacts of the species on rivers, especially for where it occurs in the Po Valley (Italy) in the EPPO region. However, there is some anecdotal evidence that the species may have impacts on biodiversity from online forums (e.g. Acta Plantarum, an Italian forum for botanists: https://www.floraitaliae.actaplantarum. org) where comments include that the species has increased from 1 to 100 plants in one year.

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* (Washitani, 2001). Miyawaki and Washitani (1996) found that plant species diversity was negatively correlated with the abundance of *A. trifida* in a nature reserve of moist tall grasslands along the Arakawa River, near Tokyo/Japan. Lee *et al.* (2010) demonstrated that the vegetation dominated by *A. trifida* in South Korea differed with regard to the composition and diversity of the species to that of the uninvaded riparian vegetation.

There is limited data on the impact of the species on habitats, except those on the problems of rehabilitation of fragile grassland environments in the USA (Megyeri, 2011). There is very little data on the invasion area on the environmental impact of infestations of *A. trifida.*

In the USA, *A. trifida* has been identified as a public health 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. The allergens are well known (Goldstein *et al.*, 1994). Today, *A. trifida* (and its congener *A. artemisiifolia*) are the main cause of seasonal allergic rhinitis in eastern and middle USA. The *Ambrosia* pollen also contributes to the exacerbation of asthma and allergenic conjunctivitis (Oh, 2018). It is recommended that individuals allergic to *Ambrosia* pollen may adjust their outdoor activities to avoid contact with the allergen (e.g. https://www.aafa.org/ragweed-pollen/). 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*. Consequently, tourism can be impaired if visitors avoid areas with high *Ambrosia* occurrence (Durham, 1949).

CONTROL

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 spread cannot be reliably prevented, as shown by the progression of *A. trifida* on the North American continent (Royer & Dickinson, 1999).

REGULATORY STATUS

In the EPPO region, *A. trifida* is is included on the EPPO A2 list of pests recommended for regulation as a quarantine pest. It is also listed by the Eurasian Economic Union (A2 List).

All *Ambrosia* species are regulated in Directive 2002/32/ EC as undesirable substances in animal feed. 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).

In the USA, *A. trifida* has the status of 'restricted noxious weed' in four states (California, Delaware, New Jersey and Wisconsin) under the Federal Seed Act (USDA, 2018) and the status of 'noxious weed' in four states [California, Delaware, Illinois and Minnesota (in two counties only)] under the Federal Noxious Weed Act and Minnesota Noxious Weed Law (USDA, https://plants.usda.gov/java/ noxComposite?stateRpt=yes; Minnesota Department of agriculture, https://www.mda.state.mn.us/plants/pestmanageme nt/weedcontrol/noxiouslist/countynoxiousweeds).

In Canada, *A. trifida* is listed as a 'primary noxious weed' under the Weed Seeds Order of the Seeds Act (http://www.gazette.gc.ca/rp-pr/p2/2016/2016-05-18/html/sor-dors93-eng.html) and as a 'noxious weed' under the noxious weed laws in the provinces of Ontario, Quebec, and Manitoba (Ontario Ministry of Agriculture, Food and Rural Affairs, http://www.omafra.gov.on.ca/english/crops/ facts/info_ragweed.htm).

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