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**National regulatory control systems**

# PM 9/30 (1) *Ambrosia confertiflora*

## Specific scope

This Standard describes the control procedures aiming to monitor, contain and eradicate *Ambrosia confertiflora.*

## Specific approval and amendment

First approved in 2020-09.

## 1. Introduction

Further information on the biology, distribution and economic importance of *Ambrosia confertiflora* can be found in EPPO (2018, 2019, 2020).

*Ambrosia confertiflora* DC. (Asteraceae) is an erect perennial herb (hemicryptophyte) that is native to the South-Western United States and Northern Mexico (USDA, 2019). It reproduces sexually from seeds and regenerates vegetatively from the base of its stem and via adaptive buds on roots (Yair *et al*., 2017).

To date, *A. confertiflora* has a very limited distribution outside of its native range. In the EPPO region, the species occurs only in Israel, where it is considered to be established and highly invasive (Dufour-Dror, 2016; Yair *et al.*, 2019). *A. confertiflora* was first recorded in Israel in 1990 and it has spread rapidly in the last 15 years through the central region of Israel and the West Bank (Dufour-Dror & Yaakoby, 2013; Yair *et al.*, 2019). In Australia, the species was introduced into Queensland in 1950. At present, it is restricted to small colonies in the country and has apparently not spread vigorously (Parsons & Cuthbertson, 2001; EPPO 2019).

*A. confertiflora* is adapted to semi-arid and arid conditions (i.e. high summer temperatures) and an extended dry season. In the native range (Arizona), *A. confertiflora* grows in dry or moist, rocky, poor quality or fertile soil. It also colonizes disturbed habitats such as roadsides and wasteland (Flora of North America, 2017). In Israel, *A. confertiflora* occurs in various natural and disturbed habitats, including dry plains and semi-arid valleys, degraded pastures, arable land, and riverbanks and dry riverbeds, but most records were found in the vicinity of rural settlements and highways (EPPO, 2019; Yair *et al.*, 2019).

Unfortunately, there is no clear information on how the species has been introduced into Israel and Australia. At present, the species has not been intercepted on any pathway into the EPPO region. Most feasible pathways for entry into the EPPO region are outlined in EPPO (2019). Fruit/seeds can be imported and dispersed as a contaminant of livestock or of animal feed mixtures. In this respect, it is believed that *A. confertiflora* has spread into Israel as a contaminant of feed grain from the Samaria region (West Bank) (Dufour-Dror, 2019). Moreover, the fruit/seeds are likely to be transported by machinery and equipment. It is also assumed that *A. confertiflora* can easily attach to clothing, boots or shoelaces as the fruits have hooked spines.

In Israel, *A. confertiflora* has been shown to have significant impacts (EPPO, 2019). *A. confertiflora* forms dense stands (up to 180 stems per square metre) that may outcompete native plant species. Such stands can suppress understory native plants, which results in environmental impacts, in particular in grasslands or in dry riverbeds. It is also a serious weed in orchards (avocado and citrus groves) and crop fields (cotton, watermelon) (Dufour-Dror, 2016). Moreover, the species is regarded as a health problem as it produces a large amount of highly allergenic pollen (Yair *et al.*, 2019).

EPPO member countries at risk are advised to prepare monitoring activities and a contingency plan for the eradication and containment of this pest.

This Standard presents the basis of a national regulatory control system for the monitoring, eradication and containment of *A. confertiflora* and describes:

- Elements of the monitoring programme that should be conducted to detect a new infestation or to delimit an infested area;

[Correction added on 10 November 2020, after first online publication: the Standard number has been amended to read PM 9/30.]


 

- Measures aiming to eradicate recently detected populations (including an incursion);
- Containment measures: to prevent further spread in a country or to neighbouring countries in areas where the pest is present and eradication is no longer considered feasible.

Regional cooperation is important and it is recommended that countries should communicate with their neighbours to exchange views on the best programme to implement in order to achieve the regional goal of preventing further spread of the pest.

For the efficient implementation of monitoring and control at a national level, cooperation between the relevant public bodies (e.g. NPPOs, ministries of environment, ministries in charge of transport, water management, etc), as well as with other interested bodies (associations) should be established.

## 2. Monitoring of *A. confertiflora*

*A. confertiflora* is not present in most of the EPPO region. Staff of organizations in charge of the monitoring of the species should be trained to recognize the plant at all stages in its lifecycle, even when present as small populations. This may include staff of NPPOs and nature conservation managers as well as botanists, agronomists, farmers, land managers etc. As this plant has the potential to grow in a range of habitats, citizen science projects may be implemented to encourage farmers, landholders, naturalists, recreationalists and other citizens to report sightings of *A. confertiflora*.

Regular surveys (see ISPM 6: *Surveillance*; FAO, 2018) are necessary to determine the geographical distribution of the plant and its prevalence. Monitoring should be conducted during the growing season of the plant and should concentrate on areas that are climatically suitable and most vulnerable to colonization (arable land, riparian habitats, ruderal environments like roadsides and transport corridors; see EPPO (2018) for a more comprehensive list of habitats). It is recommended to monitor close to points of entry.

## 3. Eradication of *A. confertiflora*

Any eradication programme for *A. confertiflora* in the case of recently detected populations (including an incursion) is based on the delimitation of the infested area within the country and the application of measures to both eradicate and prevent further spread of the pest. The feasibility of eradication depends on the size and designation of the infested area, the density of the population and the accumulated seed bank, and the accessibility of the site. Eradication may only be feasible in the initial stages of infestation.

Eradication measures are described in Appendix 1.

## 4. Containment of *A. confertiflora*

The containment programme for *A. confertiflora* in the case of established populations is based on the application of measures to prevent further spread of the species in a country or between neighbouring countries. Containment measures are described in Appendix 2.

## 5. Communication and collaboration

Regional cooperation is essential to promote phytosanitary measures and information exchange in identification and management methods. NPPOs can provide farmers, land managers and stakeholders with identification guides and facilitate regional cooperation, including information on site-specific studies of the plant, control techniques and management. Professionals (e.g. administration) should be informed about the threat to natural and managed land, and about preventive measures. Integrated management, involving different sorts of land managers and various management measures, will be more effective and efficient.

Citizen science projects may be implemented to encourage farmers, landholders, naturalists, recreationalists and other citizens to report sightings of *A. confertiflora.*

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## Appendix 1 Eradication programme

The national regulatory control system involves four main activities:

(1) Surveillance to fully investigate the distribution of the pest;
(2) Containment measures to prevent the spread of the pest;
(3) Treatment and/or control measures to eradicate the pest when it is found;
(4) Verification of pest eradication.

Eradication depends on effective surveillance to determine the distribution of the pest and containment to prevent spread while eradication is in progress. Any eradication measures must be verified by surveillance to establish if attempts and measures have been successful. Staff in charge of the control of the plants should be warned about the health risk associated with the species and should avoid touching the plant with bare skin.

### 1. Surveillance

A delimitation survey should be conducted to determine the extent of the distribution of *A. confertiflora*. Surveillance should be carried out in likely places of introduction of *A. confertiflora* such as open disturbed habitats, dry riverbeds, arable land (including abandoned agricultural land, crop fields and perennial cropping systems, e.g. vineyards, orchards). High-risk places of introduction include entry points, harbours and cargo yards (places of loading). Particular attention should be given to areas adjacent to infested sites that might receive seed and root fragments by natural and human-assisted spread, such as ruderal environments and transportation networks (roadsides and railway embankments). *A. confertiflora* is mostly found in habitats with natural or human disturbance. Surveillance should also be increased in areas of EPPO countries where there is a high risk of entry and invasion by the species (EPPO 2018).

### 2. Containment measures

Unintentional transport of seeds and root fragments through the transfer of soil material, human activity, and the movement of grazing animals, vehicles and machinery should be avoided. Movement of soil from infested areas should be prohibited. Equipment and machinery should be cleaned to remove soil before moving to an uninfested area (see ISPM 41: *International movement of used vehicles, machinery and equipment*; FAO, 2017). NPPOs should provide land managers, farmers and stakeholders with identification guides including information on preventive measures and control techniques. Additionally, identification guides with biosecurity measures can be provided to recreationalists (e.g. hikers). See, for example, the *Ambrosia confertiflora* information booklet from the Israel Ministry of Environmental Protection (Dufour-Dror & Yaacoby, 2013).

### 3. Treatment and control

At present, only a few control methods for *A. confertiflora* have been evaluated (Table 1). Further studies to assess control measures could be carried out in countries where the species is present. It is believed that it is difficult to get rid of *A. confertiflora* populations because of the plants' deep and dense root network and high regenerative ability. In general, a combination of multiple weed control strategies (e.g. mechanical + chemical control) is advised as it can aid the successful management of perennial weed species (Miller, 2016).

A prediction model developed recently contains information on the significance of the temperature on the above- and below-ground development of *A. confertiflora*. According to this model, the threshold for rhizome sprouting occurs after 30 growing degree-days (GDD) while seeds germinate after 50 GDD (the model was developed under

**Table 1.** Effectiveness of the main control methods for *A. confertiflora*

| Methods | Effectiveness | Comments |
|---|---|---|
| Uprooting | +++ | Only for seedlings, suitable for all habitats, labour intensive method. |
| Herbicides | +(+) | Few effective pre- and post-emergence herbicides are available (e.g. imazapyr, aminopyralid), but only limited experience is available yet. Repeated applications will be required. |
| Cutting/mowing | -/+ | Species resprouts and regenerates quickly. Repeated cuttings may enhance effect. |
| Tillage | - | May spread rhizome fragments and stimulate root budding. |
| Cutting/mowing + herbicides | ++ | Physical removal (cutting) and subsequent application of imazapyr or indaziflam. |
| Cultural control | ++ | Seeding/establishment of competitive plant species after removal. |

The potential effectiveness is indicated with a + symbol where +++ is the most effective. A - symbol indicates that the control method may be counterproductive. Effectiveness may be scale, site and habitat dependent.

daily constant temperature). The model can be used for prediction of plant development and for optimizing its control by removing the species at the right time (Kapiluto, 2017).

### Chemical control

It should be highlighted that the availability of products containing active substances will vary nationally and other products may be available and effective. Indications of the approved uses for each active substance may be incomplete. Products should be used following the instructions on the label and in line with the relevant plant protection product regulations.

Until now, studies on *A. confertiflora* management with herbicides focused primarily on glyphosate and auxin-like herbicides.

Parsons & Cuthbertson (2001) recommended spraying *A. confertiflora* at the budding stage with 2,4-D, triclopyr, dicamba or picloram + 2,4-D. Applied in pastures, these products only suppressed *A. confertiflora* but allowed the pasture species to compete more successfully.

The active substances glyphosate (2.5% and 5%) and triclopyr (2.5% and 5%) have been tested in Israel and they were considered not to be very effective as *A. confertiflora* recovered rapidly (EPPO 2019). Recent greenhouse/screenhouse pot plant experiments demonstrated that *A. confertiflora* can be successfully controlled pre-emergence by the active substance oxyfluorfen (240 g/L). In post-emergence experiments, the plant was controlled by imazapyr (250 g/L) and saflufenacil + glyphosate 29% at 480 g/L. The use of indaziflam (500 g/L) pre- and post-emergence showed good results (Goldwasser et. al., 2019). In screenhouse and field experiments, Yaacoby & Rubin (2019) showed that spraying aminopyralid (240 g/L) or applying it directly on leaves were effective against young and mature plants. The combination of mechanical (mowing/cutting) and the application of imazapyr aids the control of *A. confertiflora*. For example, better results were obtained when imazapyr was applied 3 weeks after a close cut of *A. confertiflora*. Eradication of *A. confertiflora* may require repeated applications.

### Mechanical control

Uprooting is only effective for the control of very young individual plants. Seedlings and smaller plants should be pulled out, ensuring the complete removal of the root system. This is a method recommended when dealing with small infestations. Uprooting of established individual plants (over 10 cm high) with a well-developed root system is no longer effective (Dufour-Dror & Yaacoby, 2013).

*A. confertiflora* has a high ability for resprouting and regenerates within 5 weeks after mowing (Dufour-Dror & Yaacoby, 2013). It is because of this high degree of regrowth that cutting methods (cutting, mowing, mulching) are deemed ineffective (EPPO 2019). This is possibly related to the lack of follow-up treatments. An effective long-term control of *A. confertiflora* may best be secured by frequent mowing that depletes stored carbohydrate reserves in the root system. However, optimal frequency for cutting dates need to be determined. In natural habitats and where the species grows near water (e.g. riverbanks), the use of herbicides is often undesirable and cutting is the only control method available.

Tillage practices are not effective at controlling *A. confertiflora*. In fact, tillage can make the infestation worse by spreading rhizome fragments and stimulating the development of root buds (Parsons & Cuthbertson, 2001; EPPO 2019). In addition, *A. confertiflora* forms a long-term persistent seedbank (>5 years, according to Thompson *et al.*, 1997) and tillage may act to move buried seed to the surface, which may promote germination.

### Cultural control

Cultural control includes maintenance practices that make it difficult for *A. confertiflora* to grow and to become established in a certain habitat (e.g. by seeding of competitive plant species). Cultural control may be used in combination with other control options (e.g. herbicide application). After removal of *A. confertiflora*, recolonizing may occur quickly because of abundant resprouting and emergence from the seedbank. Thus, it is recommended to actively restore (natural) plant communities and to establish competitive

vegetation (Schuster *et al.*, 2018). In Israel, the revegetation of riverbanks with *Arundo donax* and *A. mediterranea* (Poaceae) successfully prevented the re-establishment of *A. confertiflora* (EPPO, 2019). However, it should be noted that native species should generally be used when restoration of invaded areas is being conducted. In general, more diverse and competitive revegetation mixtures have been shown to have a greater success in suppressing invasive alien plants (Schuster *et al.*, 2018).

#### Disposal

After removal of *A. confertiflora*, plant material (in particular rhizome fragments) should not be discarded in the natural environment. It may be taken to officially approved sites for disposal (e.g. municipal recycling sites or composting facilities, specialized contractors) in accordance with national regulations.

#### 4. Verification of pest eradication

Frequent monitoring of the treated sites is important for prevention of re-establishment. Manual, mechanical measures and chemical application should be conducted until no emergence of *A. confertiflora* is found. It is believed that seeds of *A. confertiflora* remain viable for several years (EPPO, 2018) and thus the species forms a long-term persistent seedbank (>5 years, according to Thompson *et al.*, 1997). Therefore, repeated visits should be made to treated sites for at least 5 years or more.

## Appendix 2 Containment programme

In the case of an established population, eradication is difficult to achieve. Containment measures aiming to prevent further spread of the species to adjacent habitats or to neighbouring countries should be applied and an integrated approach for the suppression of populations of *A. confertiflora* is recommended.

#### 1. Surveillance

See section 1, Appendix 1.

#### 2. Containment measures

Containment measures regarding the prevention of the spread naturally or through the movement of soil, machinery, livestock or any contaminated commodity should be applied (see Appendix 1).

For chemical, manual, mechanical and cultural control options of *A. confertiflora*, along with the disposal of plant material and habitat restoration measures, refer to Appendix 1.

#### Biological management

At present, no biological control agents are available for *A. confertiflora* in the EPPO region. The natural enemy, the stem-galling moth *Epiblema minutana* (Kearfott, 1905) (Lepidoptera: Tortricidae), has already been found in Israel (Gilligan *et al.*, 2020) but currently shows no significant impact on *A. confertiflora* populations in the field (Yaacoby & Seplyarsky, 2011).

Preliminary host range data shows that *Ophraella communa* (LeSage 1986) (Coleoptera: Chrysomelidae) adults feed and lay eggs on *A. confertiflora*, and larvae can develop (personal communication, H. Müller-Schärer, University of Fribourg, CH, 2020).