



Complex research on methods to halt the Ambrosia invasion in Europe HALT Ambrosia			
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## Introduction

The invasion of common ragweed, *Ambrosia artemisiifolia*, can lead to severe negative impacts depending on eco-climatic, social and habitat conditions in a country or region. It is therefore undesirable to variable degrees. Strategies to prevent its invasion and establishment, to control and eradicate the plant and/or to mitigate its impacts are therefore recommendable. They should be based on information about the presence and establishment, the climatic suitability of the country, the prediction of potential impacts and on the presence of invasion pathways. We therefore propose to design and implement such strategies depending on the presence of the plant in a given country (or other geographical unit where applicable).

Currently there is only limited knowledge on the influence of common ragweed on the accompanying plant species. In studies from Hungary it is demonstrated that ragweed suppresses rare plants and other weed species and thus having negative impacts on the agro-biodiversity. A monitoring of these areas is recommended.

## Risk assessment

Risk assessment should be carried out in order to determine whether *Ambrosia artemisiifolia* could establish in the country under current and/or under climate change scenarios. Risk assessment should follow established procedures as described in the IPPC’s ISPM 11 (in particular annex 2), or the EPPO decision support scheme (EPPO PP 5/3). Climate modelling tools, such as CLIMEX may be useful.

Should the assessment result in a low risk of ragweed invasion for a given country, the following may be of low importance. If the risk assessment shows a higher probability of ragweed establishment and spread, preventive measures are recommended because prevention is the most cost-efficient strategy for the reduction of negative impacts.

## Countries where common ragweed is not widely distributed

Common ragweed has been involuntarily introduced to many regions and countries in the world – probably including all European countries. It has established and spread to different degrees, with

high infestation rates in, e.g., Hungary, Serbia, Croatia, Slovenia or parts of Austria and Slovakia, intermediate frequency in, e.g., Germany, Poland, Czech Republic, and virtual absence of established stands in Northern countries like in Scandinavia. Most of the invasions started following the introduction in the 19<sup>th</sup> century. In some countries the invasion is a more recent phenomenon, e.g., Germany, where the plant was present but not spreading for the first 100 years after its introduction. Such lag phases in biological invasions are not uncommon and underline the need to be prepared for potential ongoing range expansion. Countries that are currently free of any established ragweed populations should still be aware of potential imminent ragweed invasion, in particular with climate change affecting the potential naturalisation.

Countries with “intermediate invasion situations” may already begin to suffer from ragweed impacts on human health and on agriculture. The beginning establishment in those countries points to the potential of a large increase in the damages because of the suitable eco-climatic conditions for further invasions. Therefore these countries should at the same time focus on the prevention of further spread, the timely eradication of population initials in otherwise un-infested parts of the country, and on the mitigation of impacts in more strongly invaded parts.

### **Prevention of import and spread of common ragweed seeds**

The most important pathway for the international transport of ragweed seed is the involuntary introduction with commodities, in particular contaminated seeds for animal consumption (bird seed) or for processing and human consumption or contaminated seeds for sowing. Animal feed including bird seed is regulated in COMMISSION REGULATION (EU) No 574/2011, but this does not apply for the same product (e.g., sunflower seed) marketed for human consumption. Even though seeds for sowing may legally contain only low amounts of seeds of other species, common ragweed’s high reproduction ability may result in a problem on the farmland. Agricultural machinery and roadside mowers from ragweed infested areas may also form an international vector of seeds. Transport of contaminated soil is an effective spreading route for common ragweed in Europe. Therefore this kind of import should be avoided. In most of the European countries no special measures are currently in place to prevent the spread of common ragweed within excavated material. Comprehensive legal regulations currently exist in Switzerland.

In countries where common ragweed is establishing, the same ways of preventing further spreading are valid like for un-infested countries.

### **Surveillance and early eradication**

In particular where the climatic conditions are beginning to be suitable in the course of climate change, information about initial populations is essential. A surveillance programme should include the information of the public about the potential risk of contaminated bird seed and about the necessity to control ragweed in an early invasion stage. Therefore a network of experts should be trained in identifying the plant and to take appropriate precautions in applying measures. Subsequently these areas have to be monitored for several years.

Small populations – casual or on the verge of establishing – are easily controlled by pulling the plants by hand. For the safety of the persons doing this, it is recommended to act before (male) flowering and to wear gloves in order to prevent skin irritations.

## Countries where common ragweed is widely distributed and abundant

Eradication of ragweed from these countries is not a feasible short-term option. Countries with a limited distribution should at the same time focus on the prevention of further spread, the timely eradication of population initials in otherwise un-infested parts of the country, and on the mitigation of impacts in more strongly invaded parts. The negative impacts of ragweed in countries where common ragweed is widely distributed is heavily felt, e.g., in Hungary, agricultural damage by ragweed was estimated at 300 Mio € and 112 Mio € annually for expenditures for human health (1.2 billion € in Germany). Strategies against ragweed in these countries should aim at minimizing the negative effects with a long-term perspective on reducing the abundance of the plant.

## Containment and control

### Arable fields

The pillars of the reduction of ragweed occurrence are a) direct measures against the plant and b) the adaptation of the crop rotation system.

The basic direct measure is the application of herbicides, where the released herbicides depend on the country. The WeedSeeker™ technology is an option with future potential, because the application of the herbicide amount can be reduced which has a positive impact on the environment and the efficiency of common ragweed control is given. Tillage is a very important control strategy in cereal stubble. After the harvest, common ragweed should have time to germinate or start growing and being destroyed by any tillage system within 7-14 days after harvest.

Crop rotation should prefer crops that either have a negative effect on ragweed germination and establishment or offer successful herbicide solutions. The former include winter cereals because the closed canopy in spring impedes ragweed germination. The latter include maize for which a large number of suitable herbicides are available and registered. Sunflower and legumes are not recommendable for heavily ragweed infested fields, because the wide row spacing allows ragweed to grow without competition. Additionally no satisfying suppression of ragweed with herbicides can be achieved. Derived from results of herbicide experiments in Hungary conducted during the HALT Ambrosia project, the following herbicides, as examples, with good to excellent ragweed control effect in cereals are: 2,4-D, amidosulfuron, dicamba, clopyralid and mecoprop-p. And in maize: 2,4-D, bentazone, dicamba, clopyralid, prosulfuron and topramezone. Clearfield™ sunflowers can be an option in countries where this technology is permitted.

For organic farming systems control strategies by soil tillage and integrated control measures like adapted crop rotation and competitive main crops are recommended.

The suppression of ragweed does not only prevent yield losses but also reduces population density and seed bank as a long-term effect.

### Roadsides

Herbicides are not legally applicable on roadsides in many European countries. Therefore mechanical control like mowing is the commonly used control strategy. Only a strict cutting regime will lead to a successful reduction of the soil seed bank by preventing common ragweed to produce seeds: a late first cutting date at the end of July until mid of August followed by frequent cutting every 3 weeks until the end of the vegetation period. When cut plant material has to be left on the site, cutting is

safe only until the early female flowering stage (BBCH 63). Mowers must be cleaned after using in ragweed infested areas to avoid seed dispersal.

### Urban-industrial habitats

The patchy mosaic of habitats in cities with different owners or managers makes it difficult to design a consistent management plan. Common ragweed may occur here in private gardens, public greens, waste places, along city streets, in industrial areas, etc. Control or – where possible – eradication of ragweed is nonetheless important, because ragweed populations in these habitats may emit large quantities of pollen in the direct vicinity of many people, and because these populations may serve as seed sources for the colonization of other adjacent habitats.

In such a situation concerted actions of several stakeholders and administrative bodies offer a chance to achieve control over a variety of habitats. In e.g., Berlin, Germany, an “Action Programme Ambrosia” was created with the participation of the Institute of Meteorology of the Free University, the Botanical Garden, the Plant Protection Service, the City Senate and others. Together they have organised a monitoring and eradication programme which has reduced the number of ragweed stands in the city considerably. The participation of the general public is especially important in urban habitats; many plants like those in private gardens can only be targeted by control if the private owners are aware of the problem.

### Pollen management

Eradication of common ragweed is generally focused on the prevention of seed production and thus the reduction of the seed bank. If successfully applied as a long term strategy this also leads to the reduction of pollen released into the air. There may be situations where a consequent control aimed at depleting the seed bank is not feasible for technical, legal, financial or other reasons. In such cases it may still be feasible to apply control measures in order to reduce the pollen emissions, in particular in densely settled towns or cities. When pollen reduction is the main aim, control measures like hand pulling or mowing should be applied earlier in the season, i.e. no later than at the beginning of the male flowering period. The measure should preferably be repeated.

## General considerations

### Precautions

Control of ragweed stands is generally desirable. It may, however, have unwanted side-effects, like negative impacts on co-occurring vegetation. In areas with habitats or species of high nature conservation value like protected landscapes or fields with rare and endangered plant species, methods should be adopted as much as possible, e.g. by applying mechanical instead of chemical methods or hand-pulling instead of mowing.

As ragweed is harmful for human health, including the pollen allergenicity and the potential to cause skin irritation, workers must always be protected, e.g., by protective clothing or by dust masks for work in flowering plants.

All control measures must be executed in a way that they do not result in spreading ragweed seeds to new areas. This consists of cleaning machinery, tools, tires, etc. from seed containing soil or plant material. Ragweed plant material containing ripe or ripening seeds should preferably not be

transported as transport may lead to seed dispersal. Such plant material should be treated in a way that kills the seeds. Besides incinerating the material, disposal in professionally operated composting or biogas plants is possible.

Many experiences like those made in the current project have shown that sustainably reducing the abundance, the seed and pollen production is achievable. Control measures are available for virtually all habitat types and scenarios. But for all that the ragweed invasions have hardly been slowed let alone stopped in most countries.

A country-wide public awareness campaign explaining the risk and the potential mitigation methods should help to join the necessary forces for a successful fight against ragweed.

### Legislation

The existence of clear legal instruments for the fight against ragweed may be a deciding success factor. This may be in the health, the agricultural, or the environmental sector. In Switzerland, for example, the placing of ragweed-related legal measures within the realm of plant protection seems to have helped its success.

Legislation for the fight against ragweed should include rules for the transport of commodities contaminated with ragweed seeds like agricultural products, obligations to report and to control ragweed stands and rules for the safe disposal of plant material resulting from control measures.

### Biological control

A complete eradication from Europe is unlikely even in the case that comprehensive control strategies are executed. The potential offered by classical biological control should therefore be regarded: if successful and safe control agents can be found, there may be suppression of ragweed even in places where no other control is performed, e.g., because of inaccessibility. While the science of biological control of ragweed is currently being developed by the COST action SMARTER, application through the release of control agents will need support by the authorities.