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Review Article

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European Safety Measures and Specific Legislation for The Control and Eradication of Common Ragweed (*Ambrosia artemisiifolia*)

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Summary

Air pollution and climate change through global warming are directly linked. Research in the field has proposed and demonstrated their link to increased allergenicity and changing patterns of aeroallergenic plants, including common ragweed - Ambrosia artemisiifolia, leading to an increase in the number of people with respiratory allergic diseases. The factor that seems to limit the spread of aeroallergenic plants is the cold climate; there are many other factors that lead to the spread of these types of weeds: transport systems (road, ship), agriculture and agro-industry, construction areas, animals (contribute to natural dispersal). In Europe, up to 12% of the population is reported to suffer from allergic respiratory diseases (allergic rhinitis and bronchial asthma) caused by the pollen grains of aeroallergenic plants. Their quality of life is impaired and the medical costs of treating these conditions are high and rising with the spread of aeroallergens and, in particular, ragweed across the continent. This research aimed to identify safety measures, prevention measures through continuous monitoring of Ambrosia artemisiifolia, including specific legislation in countries affected by the spread of this weed; identify control and eradication practices, and the costs allocated to the treatment of respiratory allergic diseases. The research method used was a systematic review of literature, scientific databases. Both the legal provisions and standards applicable in the different European countries and the measures and ways to raise awareness of the population affected by the spread of common ragweed were identified; from the studies that were used for this research, we also identified the measures used to eradicate the weed, the monitoring/safety measures, information on the spread of the weed in the last two decades (by clearly delimiting the affected areas) and the costs per treatment for respiratory allergic diseases (allergic rhinitis and bronchial asthma) in the most affected countries in Europe. The use of alert systems, local and regional cooperation against the spread of common ragweed pollen and the exchange of information on identification methods, eradication techniques and subsequent management of the spread of common ragweed should be considered essential. Uniform legislation and the application of common eradication techniques at European level may further contribute to slowing down the spread of this plant and, in addition, to reducing the morbidity caused by respiratory allergic diseases as well as the costs for the treatment of these diseases.

Keywords: Common Ragweed; *Ambrosia Artemisiifolia*; European Safety Measures; Monitoring, Control, Eradication; Climate Change; Air Pollutants; Aeroallergens; Specific Legislation

1. Introduction

In Europe, air pollution is considered the greatest environmental risk to human health, and in 2019 it was attributed to around 400,000 premature deaths, and is also associated with allergic diseases (allergic rhinitis, bronchial asthma, atopic dermatitis), which are on the rise worldwide [1,2],[4-8]. Anthropogenic influences also contribute, in addition to air pollution and climate change, to the increase in the number of people with respiratory allergies and bronchial asthma [9]. As a preventive measure, pollen levels in trees, grass and common ragweed are monitored

daily in many countries, including European countries [3,4][9,10].

Common ragweed (throughout this paper we will refer to it as *Ambrosia artemisiifolia* or common ragweed) is an herbaceous plant, which has spread rapidly in recent decades throughout the world, including European countries, and is now a real danger to human health and the environment [7,8]. The spread of pollen from aeroallergenic plants, such as common ragweed, poses a significant challenge to health systems and is considered a national public health problem in many countries [7,8].

Rapid weed growth and the pattern it follows contribute to its spread, which is difficult to control [9,10]. Climate change (through global warming) and atmospheric air pollution (through aeroallergen-carrying particles) increase the allergenicity of this weed, with a direct negative effect on human health [9,10].

The presence of common ragweed is reported in large regions around the world: the areas of origin are North America (Mexico, USA, Canada) and South America (Argentina, Brazil, Chile, Uruguay, Paraguay). However, it is also found in areas such as South Africa, Asia (China, South Korea, Japan), Australia, New Zealand [9,10].

In October 2019, a retrospective analysis was published in the Medicina Journal [20-21]. In this analysis it is considered that in Europe the highest concentrations of common ragweed have been reported in countries such as Hungary - considered the most affected European country, parts of Romania, France (Rhône Valley region), Italy (north-western area of Milan and southern area of Varese), Germany, Switzerland, Austria, northern Portugal, Montenegro, Bosnia and Herzegovina, Croatia, Serbia, Slovenia, Slovakia, Greece. High concentrations of the weed are also found in eastern Ukraine (on the border with Hungary and Romania) and in south-western Russia [8].

In August 2022, another retrospective analysis [7] was published in the International Journal of Environmental Research and Public Health and reconfirmed previously published data, bringing back into focus the countries with the highest concentrations of common ragweed pollen [5,7].

Ambrosia artemisiifolia pollen grains are statistically believed to cause allergic respiratory diseases in at least one fifth of the European population. According to the results of the ATOPICA* project, it is estimated that by 2050 there will be an average four-fold increase in the concentration of pollen from these plants (https://www.atopica.eu/) [7]. (**Atopic diseases in the context of climate change and air quality*)

The current research aimed to identify safety measures and continuous monitoring of *Ambrosia artemisiifolia*, including local legislation in countries affected by the spread of this weed, with a very important role in actively controlling the spread of the weed; control and eradication practices used in these countries, as well as possible costs allocated to the treatment of allergic respiratory diseases (allergic rhinitis and bronchial asthma), considered a public health problem, in the context described above [11-14].

2. Materials and Methods

In our research, in order to obtain the proposed results, we used a systematic analysis of literature/scientific databases, according to the PRISMA-ScR guide [15] - books, [16-18] scientific articles, legal provisions and standards applicable in the European countries most affected by the spread of common ragweed.

EMBASE and PUBMED databases, The European Respiratory Journal, The International Journal of Environmental Research and Public Health (MDPi), Cambridge University Press, Academic.edu, International Schoolary, The Jounal of Echology and SMARTER - Sustainable Management of *Ambrosia artemisiifolia* in Europe, The Weather Channel, EPPO Global Database, EIONET Portal, as well as specific national legislation were reviewed.

In our selection, the recommendations in the PRISMA-ScR guidelines [15] helped and guided us to be able to carry out our research and report our results properly.

In order to carry out this paper, we used the following key search terms: '*Ambrosia artemisiifolia'*, 'common ragweed', 'European safety measures', 'prevention, monitoring, control, eradication'. Subsequently, we added other secondary key terms to our search: "climate change"; "air pollutants"; "aeroallergens"; "specific legislation". When deciding on the selection of materials used, we only considered those scientific articles, books, legal provisions and regulations that were directly related to our intended purpose.

The information we used as references for this paper was selected based on the answers to several questions (used as inclusion criteria): (Q_1) are there ongoing monitoring activities (national control system) and contingency plans (for public awareness, monitoring, eradication and control of the spread of this weed)? (Q_2) is there local legislation in each country affected by common ragweed in the national continuous monitoring programme? (Q_3) what are the current practices for control and eradication of common ragweed? (Q_4) what are the costs allocated for the treatment of respiratory allergic diseases in regions threatened by the presence of common ragweed?

Everything we selected as reference information was assessed both qualitatively and in terms of its relevance to the development of this paper; thus, only those articles that we considered relevant and that answered the control questions were used in the final analysis; other articles that did not meet the assessment were excluded from our research. We also selected guidelines and recommendations from internationally recognised institutions or organisations such as the World Health Organisation.

The database search found 82 scientific articles and books, published in the last 20 years, from which we selected general

information and specific, quantifiable information about *Ambrosia artemisiifolia* that answered our questions. Of these, only a subset - comprising 58 scientific articles and books - was used as a reference, following verification and selection according to the inclusion criteria. All duplicate studies we eliminated after the first selection stage.

We also used a document quality assessment checklist that included document quality assessment questions and simple answers: (Q_1) the document describes ongoing monitoring activities and intervention plans for common ragweed: (+1) yes/(+0) no; (Q_2) document describes national/local legislation, in national/local continuous monitoring programme for common ragweed: (+1) yes/(+0) no; (Q_3) document specifies current practices for control and eradication of common ragweed: (+1) yes/(+0) no; (Q_4) document describes national costs for treatment of respiratory allergic diseases: (+1) yes/(+0) no. However, the literature reviewed does not make a clear delineation between the different types of measures, which made our task of selecting information extremely difficult.

The summary description of the steps followed during the selection from the databases is presented below, following the flowchart according to PRISMA 2020[15] , which we have used as a model, and in which are indicated in turn: the initial selection stage, the screening stage, the eligibility stage of the documents and the final selection stage - see Figure 1.

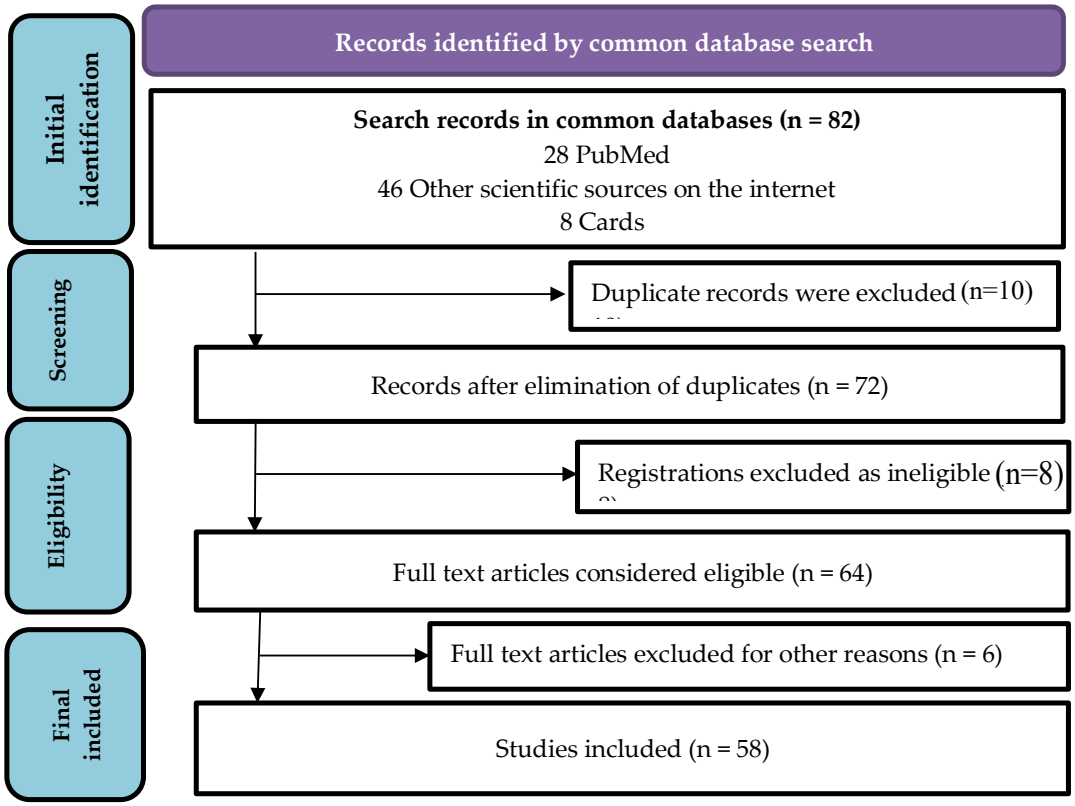

Figure 1. ***Search, identification, screening, eligibility and selection in scientific databases***

Results and discussions

General information about ragweed, its prevalence, the population exposed and the effects in the human body

In the literature, common ragweed has been described as an annual plant that produces large quantities of pollen - between 3,000 and 6,000 seeds can be generated annually by a single plant [8,9]. The pollination period has been described as starting in mid-July and, depending on climatic and soil conditions, peaking in August-September. However, given the increasingly warmer climate (in the last decade), the common ragweed pollination season can start earlier (May/June) and last longer (October/November) each year. Hot, dry summers are thought to be favourable for the wind-borne spread of pollen of this invasive weed over months [19]. Common ragweed can colonise and disturb the habitats it reaches [20]; a suspended pollen concentration <30 pollen grains/m³ of air is considered sufficient to induce an allergic reaction; highly sensitive individuals may also experience symptoms from as little as 1-2 pollen grains/m³ of air [8,9].

In European countries, where common ragweed pollen is one of the main causes of seasonal respiratory allergic diseases and a real public health problem, safety and control measures are considered necessary to limit the spread of this weed. Experience in these countries has shown that common ragweed infestation occurs

over a long period of time (years) in a given area before allergic sensitisation starts to be reported [8,9].

An average prevalence of common ragweed sensitisation of ~14% was found, with variations depending on the prevalence of this weed in each country: 54%, the highest value, was reported in Hungary (considered the most infested country in Europe) and 2.5%, the lowest value, was reported in Finland. Since 2004, common ragweed has been included on the EPPO - The European Public Prosecutor's Office's List of Invasive Alien Plants and is regulated in several countries at European level [51].

According to research data, common ragweed grows spontaneously and thrives mainly in urban and rural areas where disturbance has already occurred (e.g. wasteland, along railways and roadsides, along streams and lakes, at the edge of forests, in areas of rubble, on vacant and poorly maintained land, in untended gardens and parks, on construction sites, in areas where excavated soil has been deposited, in cereal and sunflower crops, causing significant damage to crops) [19,20]. A practical finding: between the increase in pollen concentration and the onset of symptoms, there is a "*window of opportunity*" of about 2 weeks; during this time, treatment could be initiated, leading to significant improvement for patients. Thus, with minimal investment in aerobiological monitoring equipment, the population can be effectively alerted to the presence of pollen in the air. By monitoring common ragweed pollen on a daily basis, allergy sufferers can track variations, especially during peak pollen periods [19].

The population possibly exposed to common ragweed pollen ranges from much higher numbers in countries such as Hungary (~5 million people), Romania (~5 million people), France (~4.5 million people), Italy (~2.5 million people), Croatia (~2.5 million people), Germany (~2 million people), Austria (~1.5 million people), Poland (~500,000 people), Macedonia (~300,000 people), Switzerland (~100,000 people) to smaller numbers in countries such as Spain (~40,000 people), Sweden (~40,000 people), Montenegro (~30,000 people), Finland and Norway (~10,000 people), Portugal (~3,000 people), the Netherlands (~500 people) [20,21].

In the current analysis, carried out over the period 2022-2023 by consulting the selected database, we selected information on European countries with a high risk of population sensitisation to *Ambrosia artemisiifolia*. At national level, continuous monitoring activities have been implemented, including the legislative framework (for an effective control strategy) and contingency plans (for public awareness, monitoring, eradication and control of the spread of this weed); work is underway to implement a national control system (early warning and rapid response systems - if necessary in case of a rapid response). Measures to monitor and manage the spread of this weed are considered essential and should be implemented promptly, especially in regions newly threatened by climate change [9,10,21].

Information on the effects of common ragweed pollen on human health and on the quality of life of patients with allergic respiratory diseases (allergic rhinitis and bronchial asthma), as well as the high average treatment costs per patient in many European countries, have been reported in the literature. The response of local authorities, based on preventive actions and minimising the further spread of this aeroallergen, has aimed at reducing existing populations of common ragweed or eradicating it completely where possible. However, with all the measures applied, the spread of *Ambrosia artemisiifolia* in Europe has not been stopped and/or significantly slowed down. There are, however, some positive results reported at local or regional level [21-24].

Safety and control measures for the spread of common ragweed

We have grouped possible safety and control measures into four broad categories [21-24]:

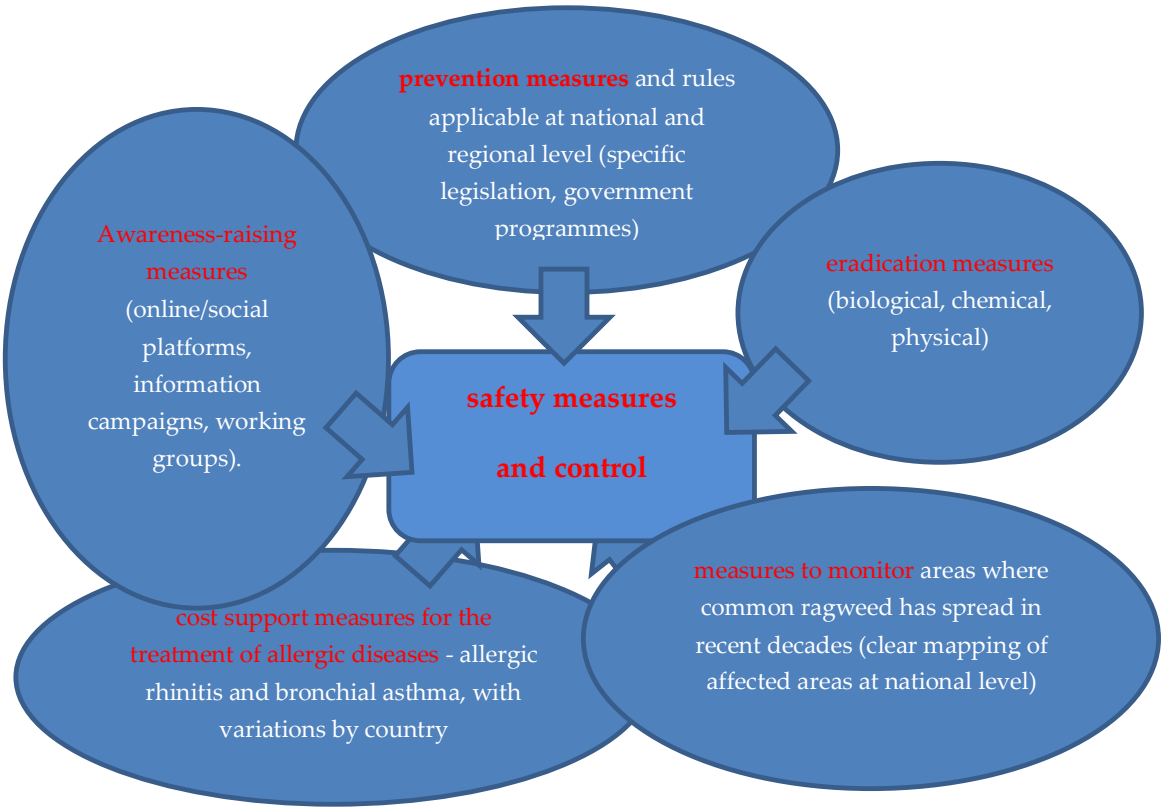

Figure 2. Safety and control measures in European countries affected by the spread of Ambrosia artemisiifolia

(1) Preventive measures and rules applicable at national and regional level (specific legislation, government programmes), public awareness measures (information through online/social media platforms, information through national campaigns, information through country, zonal or European level working groups) - differ from country to country and include:

(a) Specific legislation, i.e. regulations at national and/or local level in certain cities or areas of a country (depending on the infestation of common ragweed), may include: requirements for the removal of aeroallergenic plants, continuous and constant collection and reporting of observations on the presence of common ragweed, use of control and eradication measures and, last but not least, applicable penalties.

(b) Public awareness programmes and government programmes, which are carried out: - either through a set of programmes, carried out by government agencies in the countries concerned, to which health and other specialists (e.g. in agriculture) contribute, - or through national and/or local campaigns, seasonal or conducted every few years, disseminating information to the general public or to groups of people affected by exposure to common ragweed (news reports, leaflets and media/social media magazines may be used).

Public awareness measures, made available through the media or online via social media, can provide useful information for the public to recognise and eliminate this weed, information on possible health problems arising from exposure to common ragweed, as well as (for some sites) the possibility for people to fill in certain observations online, but also to report the presence of common ragweed in certain areas.

(c) Meetings in working groups, which may take place between representatives of local communities and representatives of government agencies, representatives of health services in the country concerned or in a particular area affected by the spread of weeds, representatives of environmental, agricultural and conservation agencies, representatives of builders and those maintaining road and highway infrastructure. Following these meetings, stakeholders should work together to develop safety and control plans and eradicate common ragweed. These types of working group meetings are initiatives that are not mandated by government regulations.

(a) Specific legislation, e.g. regulations at national level or local regulations in certain regions or cities (depending on *Ambrosia artemisiifolia* infestation).

(a.1) In France, there is a national strategy to control the spread of *Ambrosia artemisiifolia*, i.e. monitoring of the territory using monitoring stations, which are equipped with a certain type of pollen trap (Hirst). The determinations are carried out according to nationally pre- established procedures using a CEN 264 data sheet (approved in December 2015 CEN/TS 16868) [21,25,26].

ANSES, the country's national public health and environmental agency, which has been using legislative rules on the spread of this weed since 1989, found that the management of *Ambrosia artemisiifolia* monitoring, control and eradication still faces some regulatory obstacles (e.g. limited enforcement power of the national strategy by local authorities, especially on private land) and issued implementing rules including: 1. Introduction of laws giving prefects and mayors in affected regions the possibility to adopt local regulations specific to this weed, coordinated at the local level by an advisor responsible for implementing control measures on the ground; 2. Involvement of representatives of the construction sector and representatives of the public works and road infrastructure maintenance (roads and motorways), together with representatives of the agricultural sector, in order to raise their awareness of the risk of the weed spreading, discussions on the earliest possible adoption of best practices (e.g. management/ cleaning of machinery used and contaminated land, etc.); 3. Protection of the health of the population and workers who are directly exposed to weed pollen [21,25,26].

(a.2) In **Italy,** the most infested region is Lombardy, where ragweed pollen is the main cause of hay fever. The peak day is reached in August (36 p/m³), according to studies. In this region, there is a local authority initiative to control, prevent and reduce the spread of the plant - the Local Hygiene Regulation (Milan), issued in 2011, which requires surveillance and mowing operations to reduce the spread of *Ambrosia artemisiifolia*, with positive consequences on the impact on public health and on the annual costs for the treatment of allergic diseases.[21, 27-29] The development and improvement of the management strategy for this weed (a set of primary prevention actions) and the epidemiological studies carried out have demonstrated the increasing prevalence of ragweed allergy in the Lombardy region and confirmed the aggressive allergic behaviour of ragweed pollen in the affected regions of this country (~40% of ragweed allergy patients suffered from bronchial asthma) [21,27-29].

(a.3) In **Hungary,** the country currently most affected at European level by the presence of this weed, there is a legal and organisational framework - Government Decision No 1230/2012 (VII.6.), which addresses the issues related to the monitoring and eradication of *Ambrosia artemisiifolia.* However, at national level, there is no uniform data collection, so it is impossible to correlate the impact on human health at national level (e.g. data on new sensitisations or prevalence of ragweed allergy in the population) and the increased level of the weed [21,30-33].

The 19 monitoring stations of the Aerobiological Network in the country, unevenly distributed across the country, showed an increase in the level of common ragweed pollen in the air, according to data collected on average pollen levels at national level. In the southern part of Hungary (including the northern parts of Serbia and Montenegro), common ragweed pollen concentrations during the peak season are higher than in any area in the rest of Europe [21,30-33].

An analysis of the development of common ragweed in the context of anthropogenic influence indicates that social land use policies after the collapse of the Soviet Union (early 1990s) may have influenced the establishment and spread of this plant in Eastern Europe. The influence of human activity - locally, regionally or globally - seems to be associated with the spread and negative impact of this invasive plant species on human health in Eastern Europe, especially in Hungary [21,30-33].

(a.4) In **Romania,** which borders Hungary on the western border, a legislative and organisational framework is currently in place to address issues related to the monitoring and eradication of *Ambrosia artemisiifolia.* Over the last 25 years, the distribution of respiratory allergic diseases has changed in all regions of Romania, initially reported in the north-western and western areas. In 2014, in Timis county (located in the western region of Romania, near Hungary), with an increased incidence of these diseases, local authorities issued local legislation to control common ragweed [20,27,28]. Subsequently, the spread of allergic respiratory diseases spread to the southern and south-eastern parts of Romania, including the Romanian Plain [21,34-39].

Anthropogenic influence, topography (latitude) and climatic factors have allowed the spread of this species in almost all areas of the country (except high hills and mountainous areas), preferring acidic, less fertile, slightly alkaline sandy soils [16], as is the case in the southern areas of Romania [21,34-39].

Romania is one of the European countries with a high awareness rate of common ragweed (according to the INSPIRED project), and the most widespread weed species is *Ambrosia artemisiifolia* [7,9,10]. In this context, in 2018, Law no. 62/2018 on combating common ragweed and the methodological rules for the implementation of the law were approved and published in the Official Gazette of Romania. In July 2020, Law No 129/2020 on combating common ragweed was published, amending Law No 62/2018 [40-41].

(a.5) In **Germany, compared to** the rest of Europe, common ragweed is considered rare, although its distribution has increased since 2000. Large populations of common ragweed are found in south-eastern Brandenburg (Niederlausitz), where the weed mainly inhabits agricultural areas and roadsides (high concentrations of ragweed allergens are found in the air). The central part of the country as well as areas at high altitudes are almost devoid of *Ambrosia artemisiifolia* (due to the non-adaptation of the plant to climatic conditions in these areas) [21,42,43].

There is no legal and organisational framework or specific legislation at national level. In the absence of these, ragweed is expected to become increasingly widespread in Germany in the coming decades. Local authorities have applied different policies depending on the spread in each federal state - for example, the Bavarian action programme using control and eradication measures for *Ambrosia artemisiifolia, which has been* particularly successful and has involved every person who finds common

ragweed clearing the area of the weed by pulling it out (which can no longer regenerate by root). For the method to be effective, concerted, multi-year action was needed. However, according to published data, it was considered that: '*preventing the spread of Ambrosia artemisiifolia in Bavaria, as well as in most other parts of Germany, is only possible in the early phase of the spread of the species, when populations and the seed bank are still small; therefore, intensification and optimisation of control measures are very important to avoid the development of large populations of* common ragweed' [21,42,43].

(a.6) In **Austria,** there is the published Austrian Federal Plant Protection Act, which contains state laws and regulations implementing plant protection measures at federal level. Local police decrees are also used to protect the health of residents in areas affected by the presence of this weed. Essl et al. state that global warming will increase the invasive success of common ragweed in Austria based on the close relationship between plant distribution and temperature in a generalized linear model [21].

Currently, fields in the east and south-east of the country are invaded by *Ambrosia artemisiifolia* pollen, with heavily infested regions (from the south-east and east to the west of the Länder). In Upper Austria, many roads are infested. In Lower Austria, the motorway network has been completely infested for more than ten years. The plant has been found to have increased in density and spread rapidly in the country in recent years; the crops most likely to be contaminated with common ragweed are: sunflower, pumpkin oil, red beans, maize, soya, cereals, potatoes, sugar beet and vegetables [21].

(a.7) In **Croatia,** under favourable weather and soil conditions, common ragweed germination has been observed as early as mid- March (with a maximum occurrence in April and May). It causes major health problems for allergic people [21,44,45]. The Institute of Public Health (IPH) monitors pollen concentrations in the air using 17 monitoring stations across the country, and data is collected daily (or less frequently, e.g. twice a week) as unique information on the ragweed website and mobile app. [20,44,45]

The Ministry of Agriculture, Fisheries and Rural Development, which is the responsible body, has issued an ordinance on the compulsory eradication of *Ambrosia artemisiifolia* in the country. In the affected areas, local municipalities have also issued their own ordinances on the monitoring and eradication of the plant [21,44,45].

(a.8) In **Switzerland,** there is now a legal and organisational framework as well as specific national legislation on the monitoring and eradication of *Ambrosia artemisiifolia,* but the abundance of this plant remains apparently stable in this European country [21,46-48].

The Swiss national law (Plant Protection Ordinance) was introduced by the Federal Office for Agriculture (Systematische Rechtssammlung: SR 916.20 "*Verordnung über Pflanzenschutz*" (PSV), "*Ordonnance sur la protection des végétaux", "Ordinanza sulla protezione dei vegetali"* (OPV)) as early as 2006. Aim of the law: control of existing populations of common ragweed and prevention of spread. Common ragweed is included in the Plant Protection Ordinance as a dangerous weed and there is an obligation to strictly control this plant (resection, eradication). Control is considered to be the responsibility of the cantons [21,46-48]. - Table 1

Country	Specific legislation, i.e. national or local regulations - in certain regions or cities *(Ambrosia artemisiifolia)*	Public awareness and government programmes *(Ambrosia artemisiifolia)*	Working group meetings *(Ambrosia artemisiifolia)*
France	*	*	*
Italy	*	*	*
Hungary	*	*	*
Romania	*	*	*
Germany	*	*	*
Austria	*	*	*
Croatia	*	*	*
Switzerland	*	*	*

Table 1. Preventive measures and rules applicable at national and regional level

(b) Increase public awareness and government programs

Awareness-raising measures, made available to the public through the media or online, and organised campaigns are essential to eliminate this weed [21]. Usually, to achieve results, these campaigns are not carried out in isolation from other measures, but in conjunction with them. The target audience (e.g. general population, professional groups) needs to understand the threat posed by *Ambrosia artemisiifolia*, how to identify it and how to eliminate it. It can sometimes happen that these awareness campaigns are limited. Thus, information may not reach accurately certain professional groups (people working in the construction industry or for road maintenance) - see Table 1.

In recent years, numerous early warning and rapid response (EWRR) systems have been implemented worldwide at national level to help prevent or eradicate aeroallergens, including *Ambrosia artemisiifolia*.

(b.1) Early warning/timely warning systems at European level [21-23,49].

(b.1.1) EPPO website and alert list of European organisations*.
EPPO is a regional intergovernmental organisation that aims to protect plants and uses preventive measures against the spread of dangerous pests.

The organisation has set up a website (*https://www.eppo.int/*) as well as an alert list (which is critically reviewed annually by a group of experts) and sends early warnings to its 50 member countries, which are advised to take action to prevent the spread of invasive plants. EPPO's alert list includes selected dangerous pests (considered a priority) that may pose a phytosanitary risk; *Ambrosia artemisiifolia* is one of the plant species on this list.
**EPPO = European and Mediterranean Plant Protection Organisation*

(b.1.2) NOBANIS* system.
NOBANIS is a European network, which establishes regional cooperation with the aim of assisting countries in the eradication and reduction of invasive alien plant species. The network uses tools to help implement preventive measures against the spread of dangerous pests.
The NOBANIS system has been developed and has in its structure an active early warning subsystem: *Early Warning - species alerts in the NOBANIS network*
(https://www.nobanis.org/species-alerts/).
The system also provides geographical information and statistical information on invasive alien plant species, including *Ambrosia artemisiifolia*, contributing to regional cooperation (website: www.nobanis.org).
**NOBANIS = European Network on Invasive Alien Species*

(b.1.3) RASFF system* (b.1.3)
The RASFF system is an active working tool that provides Member State authorities with information on measures relating to serious risks to human health from food, feed or food contact materials. (*website: http://ec.europa.eu/food/food/rapidalert/index_en.htm*).
Any RASFF member country must immediately notify the European Commission, using the alert system, if it has information on an identified serious risk to human health (arising from food, feed or food contact materials) - https://food.ec.europa.eu/plants_en. The notifying country will also report on: the product and its traceability, the risks identified, the measures to be taken. Depending on the severity of the risks identified and the distribution of the product on the market, the notification can be considered as: alert, information or border rejection notification.
**RASFF = Rapid Alert System for Food and Feed*

(b.2) National early warning systems, national/local public information and education campaigns at national/local level

(b.2.1) In **France,** a *"clinical index"* is used, which is calculated throughout the *Ambrosia aertemisiifolia* season with the help of a network of doctors; in recent years, in the Rhône- Alpes region of France (an area where there is a high exposure of the local population to the pollen of this weed), it has been found that the "*annual pollen index*" and the "*clinical index*" have increased in most French resorts [25,26]. In these areas, allergic or potentially allergic people are in close contact with health professionals, who help to inform the public and promote the exchange of information at local and regional level, thus developing "*sentinel*" networks involving both doctors and patients [21,25,26]. In France, in the Rhône-Alpes region, there is a specific website for the general public on *Ambrosia aertemisiifolia*: *http://www.ambroisie.info/*.

(b.2.2) In **Italy,** in the Lombardy region, in order to monitor, prevent the spread and reduce the amount of Ambrosia aertemisiifolia pollen, information and education campaigns have been launched for public authorities and local population, as well as on-the-spot controls (continuous daily monitoring of the air in the area for the increase of the pollen value of the plant; delimitation, surveillance and monitoring of the area declared infested by common ragweed, etc.) [21][27,28]. In Italy, within the municipality of Capralba, there is a website describing Ambrosia aertemisiifolia and how to recognise this plant. Other useful information for interested people - whether the general public or specific professional groups - can be found on the site:
http://www.comune.capralba.gov.it/servizi/emergenze/ambrosia.aspx
(b.2.3) In **Hungary,** numerous attempts have been made to control common ragweed infestations. The large number of people suffering from respiratory allergic diseases caused by common ragweed pollen in Hungary has led to the drafting of a normative document, which regulates how citizens can fight the spread of this plant and the obligations they have in this respect [20][30-33].
(b.2.4) In **Romania,** until specific legislation is drafted, public awareness measures have been adopted and implemented: in 2017, the Romanian Society of Allergology and Clinical Immunology launched the national campaign "*Beware of ragweed*", informing the population and local and central authorities about the risk of the spread of this plant and its possible effects on the health of the urban population [21][34-39].

Law No 129/2020, which amends Law No 62/2018 on combating common ragweed, concerns the establishment/updating of the weed destruction procedure and the measures to be taken to limit the area of spread of this invasive species, as well as the methods of its removal and eradication (by the Ministry of Agriculture and Rural Development and the Ministry of Environment, Water and Forests), which carry out annual information and awareness campaigns in the media, online and in writing, especially during the peak weed control period [21][40-41].

Romania also has specialised websites, both at the level of large cities and at the national level, with which the population is informed in real time, by means of interactive maps, about *Ambrosia artemisiifolia*, where the population can also report

- map at the level of Bucharest: *https://www.hartaambroziei.ro/?lat=44.405&lng=26.0718&zoom=15;*
- country map (ambrosia.ro): *https://www.ambrozia.ro/harta-ambroziei-ro/*

(b.2.5) In **Germany,** measures taken against the spread of common ragweed are active control programmes (ongoing) and voluntary efforts in some federal states, public awareness campaigns (started as early as 2005, some of them still ongoing today) [21][42-43]. Allergists in this country are actively participating in voluntary local campaigns to inform the public about ragweed: "*Make sure you recognise ragweed", "Remove ragweed when you see it", "Report large or small ragweed populations to the authorities"*. In some regions, such as Hesse in Germany, large-scale information campaigns have been carried out.

Germany also has a larger number of specialised sites with useful information about *Ambrosia artemisiifolia* [20][35][36][48]: http://www.ambrosiainfo.de, Germany, Brandenburg: *http://www.mugv.brandenburg.de/cms/detail.php/bb1.c.189328.de,* Germany, Berlin: *http://www.ambrosia.met.fu-berlin.de/ambrosia/index.php,* Germany, Württemburg: http://www.lubw.baden-wuerttemberg.de/servlet/is/26311/

(b.2.6) In **Austria,** the information measures adopted are surveys and/or monitoring programmes carried out by individual governmental and non-governmental organisations.

In the past, due to lack of funding, the programmes were not carried out consistently; thus, the implementation of management strategies did not reach all target groups and all relevant end-users. Nowadays, stakeholders can report information on this weed online [21].

The Austrian website for information about *Ambrosia artemisiifolia* is: *http://www.noe.gv.at/Gesundheit/Gesundheitsvorsorge-Forschung/Umweltmedizin-und-Umwelthygiene/GS2_Gesundheitsvorsorge_Ragweed.html*

(b.2.7) In **Croatia,** the Institute of Public Health (IPH) participates in educating the public, pre-schoolers and schoolchildren through the activities of the "European Mobility Week" on the identification and importance of common ragweed removal. In collaboration with the Municipal Public Health Office, which issues an educational brochure on common ragweed, the IPH organises annual ragweed removal activities in urban areas [21][44,45].

In this country, every pollen season is followed by the publication of numerous articles, TV reports, talk shows and radio spots about plant allergenicity. In eastern Croatia, in Osijek, a website is used to inform the population about *Ambrosia artemisiifolia: https://ambrozijaosijek.crowdmap.com/*

(b.2.8) In **Switzerland,** by law, there is a general obligation for the population to report to the cantonal authorities (meetings for farmers are mandatory) in localities where common ragweed is found (in outbreaks) and an obligation to actively control the spread of weeds in these areas. The functions of the local public health authorities are to advise and collaborate with the municipalities, to inform and raise awareness for the application of the egislation in this country [21][46-48].

In Switzerland there have also been *national campaigns, such as the national campaign of the ragweed working group*. Information about *Ambrosia artemisiifolia* can be found on Swiss websites such as: *http://www.ambrosia.ch/.*

Communication tools	Professional groups = Experts	General public	Target audience	Decision makers	Economic sector
Standard information	-	*	*	-	*
Websites	*	*	*	*	*
Articles	*	*	*	*	*
Conferences	*	*	*	*	*
Workshops	*	*	*	*	*
Brochures	-	*	*	-	*
Posters	-	*	*	-	*

Table 2: Communication tools and target audience

(b.3) Early warning/early alert systems outside Europe at US and Canadian level

We have previously described the information obtained on early warning/early warning systems at the European level, and in this sub-chapter of our paper we provide additional information on the use of these systems in the US and Canada. In this way, we will also be able to understand how they are set up in the 2 major areas of the world [20].

European colonization of *Ambrosia artemisiifolia* seeds is generally believed to have occurred through three distinct mechanisms - seed dispersal from neighbouring common ragweed populations, germination from the seed bank, and importation of these contaminating seeds from the USA, Canada and some invaded European countries. Colonisation only occurs if these seeds can germinate and if there is habitat available for colonization [19][21].

(b.3.1) *Ambrosia artemisiifolia* is an invasive weed native to **North America**. However, the U.S. NISC*, which coordinates the activities of U.S. states and states in the region to implement their own Early Detection and Rapid Response (EDRR) systems, issued an Executive Order (EO 13112) that encompasses Federal programs and activities for the prevention and control of invasive species and established a Federal EDRR system for invasive species. The Executive Order refers to exotic species, which could include *Ambrosia artemisiifolia: "...with respect to a particular ecosystem, any species, including seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem."* [19][21].

The EDRR comprises several stages: (1) early detection, the stage that provides the first information about the presence of an invasive species; (2) rapid assessment, the stage at which the first interventions can be recommended or an intervention can be initiated; (3) rapid response, the stage at which invasive populations can be isolated and eradicated [19][21].* NISC = *National Invasive Species Council, EDRR = Early Detection and Rapid Response*.

(b.3.2) In **Canada,** *an "Invasive Alien Species Strategy for Canada"* (since 2004) is in place, which established a centrally coordinated national policy and management framework that minimizes the various risks of invasive alien species, including *Ambrosia artemisiifolia*. With this strategy, Canada has proposed prevention methods, through early detection, early warning and early response methods, as well as management methods (through containment and eradication of invasive alien species) [19][21].

Information about this plant can be found on several sites in Canada, for example *https://www.canada.ca/en/environment-climate-change/services/biodiversity/invasive-alien-species-strategy.html.*

(c) working group meetings, which may take place between representatives of local communities and representatives of government agencies, representatives of health services in the country or in a particular area affected by the spread of weeds, representatives of environmental, agricultural and nature protection agencies, representatives of builders and those maintaining road and highway infrastructure.

Following these meetings, stakeholders should work together to develop safety and control plans and to eradicate common ragweed. These types of working group meetings are initiatives that are not required by government regulations [21-23].

(2) Eradication measures (biological, chemical, physical) [21,22,23],[49,50,51]

(a) Biological measures are: cultivation/seeding of competing vegetation, crop rotation and control of animals that can spread common ragweed; use of 'natural enemies': insects and fungal pathogens.

(b) Chemical measures are: spraying of herbicides.

(c) Physical measures are: cutting and uprooting plants, mowing and weeding, ploughing, burning etc.

(2.a) Biological measures (cultivation/seeding of competing vegetation, crop rotation and control of animals that can spread common ragweed)

In Hungary, Romania, Austria, the eastern part of Croatia and Germany (in Bavaria), biological eradication is also being attempted in addition to chemical and physical measures.

Stopping the spread of *Ambrosia artemisiifolia* in Europe is achieved by specific measures - reducing flowering as well as seed deposition at ground level. It is also important to reduce seed dispersal, locally and regionally. However, it is considered that to mitigate crop losses caused by common ragweed, it is important to reduce biomass rapidly.

To be effective, biological measures should follow a strategy consisting of two distinct parts: (P1) one part comprising the classical approach, for areas heavily infested by common ragweed (fallow land, roadsides, riverbanks, meadows), using agents that reduce flowering, pollen production and seed production; 18 insects (of which only 6 insects were chosen) and 5 fungal pathogens (of which only one species of fungal pathogen was chosen) were identified that can be used in a classical biological control approach; organisms that feed on flowers, pollen and seeds, as well as organisms that contribute to the reduction of seed production are considered very important in the classical approach; (P2) a part covering the invasive approach, for fields with a crop heavily infested by common ragweed.

Currently, in **Hungary**, the European country with the highest prevalence of common ragweed pollen, biological measures, including the classical approach to the plant, are considered feasible to stop its spread in this country.

According to the selected studies, it is considered that biological methods should not be too specific (genotype or host strain) and should take into account genetic differences between populations, as there are often large variations within common ragweed populations in different countries. On the other hand, it is expected that 'natural enemies' (which rapidly reduce biomass) should be chosen so that they are suitable for the application, but also to rapidly reduce crop losses. Research under greenhouse conditions has shown that concurrent vegetation sown at the same time appears to be very effective in reducing common ragweed density and therefore preventing the development of more weed pollen seeds. Experimentally, in the countries mentioned, competitive plant species are sown on newly constructed roadsides.

The majority of biological control agents for common ragweed have so far been collected from the eastern United States and Canada. For biological measures comprising the classical approach to have stable and persistent results over time, it is necessary to target regions with climatic conditions comparable to those of

the invaded area in Europe. Thus, several species associated with this beetle in its native range have been proposed for consideration as potential biocontrol agents.

When biological control measures are used as part of a management programme for *Ambrosia artemisiifolia* in Europe, priority should be given to organisms that appear to have the potential to negatively impact the growth or rapidly reduce the biomass of this weed.

It can be concluded that: (1) a combination of biological measures with other tools (chemical and physical measures) is necessary to achieve acceptable levels of overall control of these weeds in crops; (2) the classical approach has been traditionally and most successfully used against invasive plants, which spread over large areas of habitats (natural and semi-natural) (Table 2).

(2.b) Chemical measures (herbicide spraying or herbiciding)

Chemical eradication of common ragweed is carried out in Hungary, Romania, Germany (Bavaria), Austria, eastern Croatia and Serbia (Belgrade). On small areas, it is used in France and Italy.

Chemical measures are almost exclusively limited to herbicide spraying, which is considered an effective method and is therefore frequently used. However, for good efficacy, the timing of the intervention, compliance with all application procedures and correct use of recommended equipment are very important.

Disadvantages of using chemical measures - spraying herbicides: possible harmful toxic effects on human health; increased production costs for farmers; increased risk of developing weed varieties resistant to the chemicals used; *Ambrosia artemisiifolia* develops tolerance to herbicides (in its area of origin).

During the growing season, common ragweed has a long germination period. Frequently, in order to achieve long-lasting control, it is necessary to use a combination of active compounds (soil and leaf) - see Table 3.

(2.c) Physical measures (cutting and uprooting plants, mowing and weeding, ploughing, burning)

In Hungary, Romania and Germany (in Bavaria), Switzerland, Austria, eastern Croatia and Serbia (in Belgrade), France and Italy, physical eradication activities are carried out, which are costly and consist of mechanical forms of physical removal of the plant from a given location: cutting and uprooting of plants, mowing and weeding, ploughing, burning, etc. Mechanical measures have included cultivation at the sprouting stage, maintenance of weed-free crops and mowing of weed-free land, etc. At local authority level, the willingness of stakeholders to pay to implement these physical measures is very limited. Thus, in practice, if the stakeholders do not have their own budget on the one hand and the necessary staff (who can carry out the work on a large scale) on the other, the results will not be as expected.

To understand the situation described, a good example might be mowing. This can only be very effective if done correctly and in the right season. Thus, by mowing correctly, the harmful effects of weeds can be reduced. Limiting the spread is possible by repeated mechanical pruning on public and private land - several pruning sessions are necessary (first pruning at the beginning of the season, before Ambrosia artemisiifolia flowers, and second pruning in September). And common ragweed should be destroyed from the time of emergence until the first flowers appear, by 30 June each year. For best effectiveness, it is recommended to combine with chemical measures. Monitoring and identification of fields infested with common ragweed should start in spring after the weed has emerged at ground level. In case of recurrence of infestation outbreaks, it is recommended to carry out repeated control work throughout the year, avoiding inflorescences.

Local public administration authorities (municipal, town and city councils) are responsible for identifying land infested with *Ambrosia artemisiifolia* and are required to inspect annually the land within their administrative area, to identify owners or holders of land, managers of public roads, railways, waterways, lakes, irrigation systems and fish ponds, and beneficiaries of construction works where outbreaks have been identified and to report them in due time. (Table 3)

Country	*Biological eradication measures (Ambrosia artemisiifolia)*	*Chemical eradication measures (Ambrosia artemisiifolia)*	*Physical eradication measures (Ambrosia artemisiifolia)*
France	-	*	*
Italy	-	*	*
Hungary	*	*	*
Romania	*	*	*
Germany	*	*	*
Austria	-	*	*
Croatia	-	*	*
Switzerland	-	-	*

Table 3: Eradication measures (biological, chemical, physical)

The EU-COST FA1203 project on "*Sustainable Management of Ambrosia artemisiifolia in Europe (SMARTER)"* (*https://www.cost.eu/actions/FA1203/accesed* on 27 January 2024) started in February 2013. The action started with the signing of a Memorandum of Understanding by 30 participating countries. More than 180 researchers have been registered as participants in the programme. Participants/confirmed (2012) from 30 countries [42,48,50,52].

COST actions have interconnected several nationally funded research projects. COST Actions have also provided funding for working group meetings, research and information exchange on research results, and for the presentation of results at conferences. SMARTER aimed to initiate and develop long-term safety and control methods; to integrate the results into existing control measures (biological - main objective, chemical and physical) and to evaluate the success of these measures for human health as well as for agriculture accordingly. To this end, models have been developed and parameterised and studies, coordinated across Europe, have been carried out on: population dynamics of *Ambrosia artemisiifolia;* impact of control measures on weed frequency and distribution; increase in pollen grains; health damage through allergic diseases [42,48,50,52].

SMARTER has enabled various stakeholders to make a selection of optimal combinations of control methods specific to each region. Subsequently, the project created an information platform, developed best practice manuals and provided a forum (to discuss long-term management and monitoring options and to develop new innovative management and monitoring solutions) [42,48,50,52].

In addition to all these, other measures include: border control (imported materials, especially agricultural products, are assessed and, if found to be contaminated, will be sent back to the country of origin), seed control (by using machinery to help sort other seeds from these weeds and, if found to be contaminated, it is recommended to restrict their sale) and control of soil contaminated with *Ambrosia artemisiifolia* (by mapping and labeling it and covering it with uncontaminated soil).

(3) Measurements of the areas of common ragweed distribution in recent decades (by clearly delineating the affected areas countrywide) shall be made by representatives of local communities and representatives of government agencies who have a direct interest in identifying, reporting and mapping the presence of common ragweed in those areas.

At European level, the most popular methods of monitoring *Ambrosia artemisiifolia* are mapping. The work is carried out in working groups and government programmes (city, community and county associations at state level, environmental authorities, environmental health services, worker protection, plant protection, agriculture, nature protection, consumer protection, law and order protection, and highway construction and maintenance). Mapping also includes multi-year visits to fields where Ambrosia artemisiifolia infestations have previously occurred and been documented.

Usually two site visits are made before and after the application of the measures to assess the outcome and it is important to precisely delimit (locate) the areas where the weed was found to avoid misidentifications [21,37].

Example: In Hungary, since 2005, the Hungarian Institute of Geodesy, Mapping and Remote Sensing (FÖMI) has developed a monitoring and control programme for *Ambrosia artemisiifolia,* called "Risk Map for Common Ragweed", using remote sensing technology (an accurate, objective and reliable method). The country-wide risk map is based on analysis of satellite images validated by a 10% ground-truthing sample [21,37].

Currently, in Hungary, remote sensing (RS) based assessment is applied to the entire arable land area and uses four monitoring technologies (RS+GPS+GIS+WEB), which leads to the (important and indispensable) remote weed recognition. The whole remote sensing system can be operational in all infested regions of Europe [21,37,54,55] (Csornai et al. 2009, 2010, Nádor et al. 2011). This information is entered into the "Central Common ragweed Server and Information System" - one of the main pillars of the common ragweed control programme in Hungary [21,37,54,55] (Csornai et al. 2009, 2010, Nádor et al. 2011) - Table 4.

Safety and control measures	It is recommended to use with
1. Specific legislation, e.g. national regulations or local regulations in certain cities or regions (depending on the infestation of *Ambrosia artemisiifolia*)	- Information and education campaigns - Monitoring and mapping - Penalties for infringements - Public involvement - Chemical measures (weed control) - Physical measures (mowing, pulling)
2. Information and education campaigns for target audiences/online information	- Specific legislation, e.g. national or local regulations - Monitoring and mapping - Multidisciplinary conferences and workshops
3. Government programmes	- Specific legislation, e.g. national or local regulations - Penalties for infringements - Information and education campaigns - Monitoring activities - Compensation payments
4. Biological measures	- Information and education campaigns
5. Chemical measures (weed control)	- Information and education campaigns - Monitoring activities - Crop rotation - Cosit
6. Physical measures - hand pulling, mowing, ploughing	- Specific legislation, e.g. national or local regulations - Information and education campaigns - On-line information/Working groups - Chemical measures (weed control)
7. Cleaning of cars/vehicles	- Specific legislation, e.g. national or local regulations - Information and education campaigns
8. Seed contamination control Soil contamination control	- Specific legislation, e.g. national or local regulations - Information and education campaigns - Cleaning of cars/vehicles

Table 4: Most common way of combining safety and control measures

(4) Measures on cost support for the treatment of allergic rhinitis and bronchial asthma (as a burden of disease on health systems)

To better highlight the true extent of the impact on human health of the spread of ragweed, we bring to the forefront support measures and estimates of annual economic costs per patient per year allocated to the treatment of allergic rhinitis and bronchial asthma at European level [14,15].

The annual economic costs allocated to treatment varied, depending on the drugs used to treat allergic reactions to ragweed. Thus, the lowest cost per patient of only €8.30 was recorded in the Czech Republic, where antihistamine drugs were used for treatment. By contrast, the highest cost per patient, €8,060, was recorded in Switzerland for the treatment of bronchial asthma. The average treatment cost per patient was €565 [8,21,57,58].

In order to be able to calculate the socio-economic costs and the real impact at the individual level, by affecting quality of life - morbidity, the ratio of medical costs to absence from work was used. The calculation was made for people living in France, Rhône Valley region (18.5%) and the estimated socio-economic costs per patient were 670 euros. This estimate was more conservative than the average cost estimate for seasonal allergic rhinitis in Europe (€964 per patient) [8,21,57,58].

Treatment costs are difficult to assess, including the average hourly costs allocated to medical staff (doctors, nurses, pharmacists) involved in diagnosing, prescribing and administering medicines.

These treatment costs shown above are calculated without taking into account the cost of non-prescription medicines in Europe. If these costs are excluded, we have practically an underestimate of the direct costs of the drugs used to treat *Ambrosia artemisiifolia.* In the US, the cost of over-the-counter medicines for allergic rhinitis has been calculated at €73 per patient per year. However, it is difficult to estimate the proportion of these additional costs. By calculating the weight of the socio-economic costs of treatment and the decline in patients' quality of life, expressed as working time lost at country level, using purchasing power parity (PPP)-adjusted health expenditure per capita, the total socio-economic costs in Europe were ~€7.4 billion per year [8,21,57,58].

Calculations of the total number of patients in Europe affected by this weed were based on the use of maps of areas of common ragweed sensitisation, which were compiled after obtaining extensive data on the spread of common ragweed pollen and geospatial delineation of these areas (mapping). Sensitisation rates of the general population as well as sensitisation rates of rhinitis and bronchial asthma patients were obtained from health centres in each country [8,21,57,58].

Among the strengths of this research is that it is based on a review of the literature, the legal and organisational framework at European level, safety and control measures, monitoring and eradication measures for *Ambrosia artemisiifolia*, which is a major public health problem in European countries. This research is part of a study carried out in Romania, which started from the idea of a possible involuntary exposure to *Ambrosia artemisiifolia* pollen, over a longer period of the year (May/June - October/November), of the population in countries affected by the spread of this weed. We investigated the possibility for authorities in affected countries to monitor and eradicate the weed, gathered information on costs per treatment, i.e. increased morbidity of allergic rhinitis and bronchial asthma in the most affected areas.

The main limitation of our study is that we could not perform a more in-depth analysis of the implementation of the specific legislation in force and the other measures declared at the level of each country included in the study; we could not perform an analysis of the impact of this plant on human health, as well as the change in the costs allocated to the treatment of allergic respiratory diseases (by decreasing/increasing them).

3. Conclusions

A main conclusion concerns the future projection of the spread of common ragweed in Europe, for which we have a conservative estimate. The potential future distribution of this plant is highly uncertain, but it is expected to move north-eastwards and, under the 811 influence of current climate change (in particular the constant increase in temperature), to extend its range in European countries, with a high invasive potential in large parts of the continent: France (northern area), Italy (southern area), Spain, Portugal, Benelux, Poland. Possible spread of the weed in Turkey and other unaffected parts of Russia (i.e. area east of the Caspian Sea).

In north-western Europe (France and Germany), it is considered that the potential distribution of common ragweed may be underestimated as both countries apply weed monitoring and eradication measures. In Switzerland, at present, the distribution of this weed remains apparently stable; a legislative and organisational framework for weed monitoring and eradication is in place and implemented. The southern part of Hungary, the northern part of Serbia and Montenegro, the north-western part of Romania and the south-western part of Ukraine show much higher concentrations of *Ambrosia artemisiifolia* pollen during the peak season than in any other areas of European countries. All these countries are neighbours of each other and have favourable meteorological conditions for the spread of this weed - high and rising temperatures, abundant rainfall, strong winds at certain times of the year.

In practice, national and regional authorities have different policies that they apply. Hungary and Romania have adopted specific national legislation as well as monitoring and eradication measures. In Croatia and Armenia, there is a high abundance of common ragweed, which causes major health problems for allergy sufferers, and the weed has a high potential to spread by 2080, when it is expected to occupy all of north- eastern, central and part of southern Armenia.

Another conclusion relates to the direct link between the spread of ragweed in European countries and the damage to human health, with a continuous increase in the number of people with respiratory allergic diseases (allergic rhinitis and bronchial asthma), requiring expensive and long-term treatment. Increased treatment costs are already being incurred in the various countries affected by the spread of this weed.

Another conclusion is that regional and European cooperation on the spread of Ambrosia artemisiifolia should be considered a priority and essential for the promotion of the models used and the exchange of information on methods for identifying and managing the spread of this weed. At European level, there are no universally valid models implemented to eradicate common ragweed, but consistently used and accurately implemented models can be very useful to limit the spread of *Ambrosia artemisiifolia* and its pollen production (e.g. specific legislation at country level, information and education campaigns, online information of the target public, biological measures; chemical measures - herbicides; physical measures - mowing once or twice a year of overgrown land, ploughing, etc.).

The effective implementation of national monitoring and control of *Ambrosia artemisiifolia* requires cooperation between relevant public bodies and the development of consistent real-time mapping of the spread of this plant.

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