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Methods of Intervention in the Control of Ragweed Spread (*Ambrosia artemisiifolia* L.) in the Area of Zagreb County and the City of Zagreb

Davorin Gajnik[1] and Renata Peternel[2]

[1] Zagreb County Institute of Public Health, Zaprešić, Croatia
[2] University of Applied Sciences Velika Gorica, Velika Gorica, Croatia

A B S T R A C T

The increase in ragweed mediated health problems has led to the development of defense strategies in the countries with the most serious ragweed pollution, namely Hungary, Italy and France. The aim of this paper is to define the frequency of allergic disturbances brought by ragweed pollen in the period between 2002 and 2004, and to devise an action plan for its eradication in the area of Zagreb, as well as in Zagreb County. Thanks to the analysis of common methods of ragweed eradication, even by stating biological ragweed eradication, the best efficiency in ragweed eradication would be achieved through a method that combines several common methods, i.e. a mixed method. In its order on taking measures for obligatory eradication of ragweed, it has stated that the Ministry will ensure funds so that Plant Protection Department in Agriculture and Forestry of the Republic of Croatia, and Department of Herbology of the Faculty of Agriculture of Zagreb could observe the beginning and continuity of ragweed blossom, make an evaluation on the degree of weed overgrowth, establish how widespread it is in the Republic of Croatia, inform the public via the media on control measures and some other duties, but there is no financial help to those who are selected to eradicate ragweed.

Key words: *ragweed, pollen allergy, ragweed eradication, Zagreb County, Croatia*

Introduction

Ambrosia L. belongs to the large dicotyledonous family Asteraceae. It is one of the few wind-pollinated members of this family. The genus contains about 40 species, only the following five of them being found in Europe: *Ambrosia artemisiifolia* L., *A. trifida* L., *A. maritima* L., *A. tenuifolia* Spreng and *A. coronopifolia* Torr et Gray[1]. Ragweed generally occurs in dry fields and pastures, along roadsidesand railway lines, and in waste grounds and fallow land in Europe. All species require a warm climate, dry soil, and sufficient humidity during the summer time[2]. Ragweed is also sensitive to competition from other plants. It disappears in dense vegetation. In Central Europe, ragweed is not found at altitudes higher than 400 m above sea level, whereas in France it grows up to 1000 m above sea level[3]. The morphology of ragweed is quite unexceptional. It is an erect, branched herb with ranging from several centimeters to more than a meter height. The stem is hairy, may be woody near the ground, the leaves are soft-green and are opposite or alternate. The flowers are green to yellowish in color and are formed by small inverted cupula[4]. Each plant produces millions of pollen grains, which spread in the atmosphere very easily. Seeds are unarmed or with teeth, and are 2–8 mm in diameter. They are produced in large quantities (from a few thousands to some 60000 seeds produced by each plant every year), and may keep their ability to germinate for up to 30 years of resting in the soil[5]. In Europe, ragweed is found in Hungary[6], Czech Republic[7], Slovakia, Poland[8], Austria, Switzerland, France, Italy (north-west regions of Piedmont and Lombardy, and north-east regions of Veneto and Friuli Venezia Giulia[9], Bosnia[10], Croatia (Zagreb surroundings, Podravina, Posavina, Srijem)[11,12], and Serbia (Voivodina)[13]. Because of its allergenic character, ragweed pollen has been monitored for a long time. The sensitization rate of subjects allergic to ragweed pollen in the popula-

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tion is quite high and still increasing. In the late 1990s positive results of skin prick test or positive RAST reactions to ragweed allergens in pollen allergic patients reached the following values: Hungary-more than 80%[14] Northern Italy-nearly 70%[15,16], France-30%[17], Czech Republic-about 35%[18], Austria-about 30%[19]. The increase in ragweed mediated health problems has led to the development of defense strategies in the countries with the most serious ragweed pollution, namely Hungary, Italy and France.

The aim of this paper is to define the frequency of allergic disturbances brought by ragweed pollen in the period between 2002 and 2004, and to devise an action plan for its eradication in the area of Zagreb, as well as in Zagreb County.

Material and Methods

Defining the frequency of allergic disturbances

Eight family doctors conducted a survey on the occurrence of allergy among their patients (14 863) so as to determine the frequency of allergic disturbances caused by pollen in the residents of Zagreb County. The sample was comprised by representatives of family doctors, one from

TABLE 1
ACTION PLAN FOR RAGWEED ERADICATION

	What	Who	Time span
1.	Preparation for drawing up of the county budget for the year and granting money to carry out the plan	Administrative Department of Health Care and Social Welfare	October
2.	Analysis of what has been done in ragweed eradication in the previous year	Administrative Department of Health Care and Social Welfare, Zagreb City Public Health Institute	October, November
3.	Pollen monitoring analysis for 200	Department of Health Care and Social Welfare, Zagreb City Public Health Institute	February
4.	Redefining methods and doers of certain actions in ragweed eradication	Administrative Department of Health Care and Social Welfare, other relevant factors	March-April
5.	Allotting money to associations and other users with the aim of eradicating ragweed	Administrative Department of Health Care and Social Welfare, Zagreb County Government	April
6.	Delegating assignment to the doers		May
7.	a) Education in nature, lessons, physical eradication, chemical eradication	Schools, doctors, agronomists, advisory services, ecological associations, farmers, communal companies	May, June
	b) Leaflets printing	Administrative Department of Health Care and Social Welfare	June
	c) 1.leaflets distribution	Administrative Department of Health Care and Social Welfare	June, August
	c) 2. Media campaign	TV, radio, printing houses	June, August
8.	Ragweed eradication, uprooting, mowing	Communal companies, volunteers, ecological associations, owners and lease-holders of land, Croatian Railways, Croatian Water Resource Management, County Roads, social assistance users	July, September
9.	a) Observation of weed pollination, especially that of ragweed	Zagreb City Public Care Institute	With continuity
	b) Bioprognsis	Zagreb City Public Care Institute	With continuity
10.	Control, focused action, reporting areas covered in ragweed	Public utility services, residents	July, September
11.	a) Passing a decree on mandatory ragweed eradication	Public utility services	July, September
	b) Areas covered in ragweed	Communal services	July, September
	c) Passing a decree for ragweed eradication, when the person failing to remove ragweed from his/her areas bears the cost	Communal services	
12.	Evaluation	All competent shareholders. Administrative Department for Health and Social Welfare, Zagreb City Public Health Institute	October, November
13.	Preparation for drawing up the budget for the upcoming year and ensuring funds for the plan's conduction	Zagreb County Administrative Department for Health and Social Welfare	October

each of the following eight towns in the County: Dugo Selo, Ivanić Grad, Jasterbarsko, Samobor, Velika Gorica, Sveti Ivan Zelina, Vrbovec and Zaprešić, which are, at the same time, the heads of branch-offices of Zagreb County's Health Center. Each of the respondents was supposed to answer the following questions: total number of patients, the number of patients out of the overall number that are allergic to the pollen of plants, the number of patients out of the overall number that are allergic to ragweed pollen, the most common way of ragweed allergy manifestation, and the therapy most commonly prescribed.

Results and Discussion

Out of the 14863 patients, 701 were allergic to the pollen. Out of 701 patients allergic to pollen, 414 were allergic to ragweed pollen. The most common reaction and manifestation of patients to ragweed, according to the doctors' answers are; the case of allergic rhinitis, allergic rhinitis with spastic bronchitis, allergic dermatitis, burning eyes, even the sensation of suffocating.

The medicine most frequently prescribed, and other aspects of therapy, involve Claritin (Loratadine), Rinolan (Loratadine), Flonidan (Loratadine), as well as nasal drops and sprays, bronchodilators – Ventolin (Albuterol) spray and the like. Alongside the very drug prescription, some doctors also provide references of desirable behavior of people suffering from allergies, meaning they should stay away from spending time in the open if possible, spending their free time in the mountains, for there is no air pollution with ragweed pollen there etc.

According to the data acquired from the Administrative Department of Health and Social Welfare or other authorized departments in the counties and the City of Zagreb, some counties recognized the problem of ragweed as a public health problem, and initiated activities to stop and prevent its expansion.

By comparing the well-known methods of ragweed eradication, the optimal approach has been selected, on grounds of which a plan of activities and an action plan have been made to destroy ragweed in Zagreb County (Table 1).

Pollen allergy is related to local vegetation and depends on the way and duration of exposure to aeroallergens, provided that there is a genetic predisposition to respiratory allergy[20,21]. Many researchers relate the occurrence of respiratory allergy symptoms to the presence of pollen grains in ambient air; in addition, it is well documented that inhalation of specific types of pollen grains causes clinical symptoms of respiratory allergy. Concentrations of ragweed airborne pollen in the atmosphere of Zagreb vary annually. The mean annual index of ragweed pollen in 2002 and 2003 was 9422, accounting for 18% of total annual index of all plant pollen, whereas in 2004 and 2005 it fell to 14%[22]. However, these values greatly exceed the values recorded in Geneva (Switzerland)[23] and Szczecin (Poland)[24] for the same period. However, our proportions are still lower than the proportion of ragweed pollen in Montreal (about 30% of total annual pollen count)[5]. A wide range of factors affect the production, dispersion and transportation of airborne pollen (wind direction and speed, rainfall and relative humidity during the flowering season)[25]. Annual variation in the ragweed pollen concentration in the Zagreb atmosphere could be explained by different weather conditions, especially pronounced in 2003 and 2004[26]. Many studies suggest that is necessary to record and correlate the airborne pollen concentrations with the most important meteorological parameter values[27,28]. Maximum ragweed pollen emissions are restricted to the summer months of August and September, the warmest and driest months of the year which is consistent with the data reported for Austria and Switzerland as well as for countries in the central part of east Europe[29–31].

The best efficiency in ragweed eradication would be achieved through a method that combines several common methods, i.e. a mixed method. Each of the known methods has its advantages and disadvantages. In that way, the most efficient method is the one of manually uprooting ragweed at the early stage of its growth, but it requires a lot of labor and it is slow. Chemical method is quite efficient at the early stage of the plant's growth, it should be conducted several times during the growth in various time spans, and it entails significant financial resources, as well as mechanization, which cannot normally reach inaccessible areas where ragweeds grow, so once again a huge share of manpower is needed if manual spraying is carried out. Chemical method proves to be most effective in the early stage of ragweed's development while, as a rule, the cultures are still not treated with herbicides.

A type of leaf beetle was found in the US, named ragweed leaf beetle (*Zygogramma suturalis*), which is a natural enemy of ragweed. This species is widespread in the USA where it feeds on ragweed, but its contribution to diminution of ragweed is negligible. Experts from former USSR introduced ragweed leaf beetle into Europe, more precisely between the Black and Caspian Sea, and according to their claims, there has been a tremendous success in decreasing ragweed numerousness. A research conducted in Zagreb has shown that ragweed leaf beetle can become domesticated in Croatia, and that its introduction does not form any threat to cultural plants[32].

A method we have not dealt with so far is a very significant one – administrative.

Administrative method does not eradicate ragweed on its own, but it definitely presents a basic regulator in its eradication. Through imposed penalties, this measure is also a financial motivator for ragweed elimination. Ministry of Agriculture, Forestry and Water Management has recognized the importance of defining and regulating mandatory ragweed eradication, passing a decree on the undertaking of measures for ragweed mandatory eradication. The decree defines who is supposed to remove ragweed, who performs supervision (competent plant protection inspection). The provision defines who bears the cost of ragweed eradication, but it does not specify

who will do it, and who will bear the cost if »it is not carried out voluntarily by the obliged persons (owners, lease-holders, and the like). Therefore, it is essential that each county passes an act, which not only defines the obligation for removal and eradication of ragweed, but also sets a fine for noncompliance with the provisions stated, and defines who will remove and eradicate ragweed, while certain people will be charged for it.

By comparing a common method of ragweed eradication, most favorable approach was selected, on grounds of which an action plan for ragweed eradication in Zagreb County was made.

Optimal approach would require that:

1. regional self-management units pass a decree on obligatory ragweed eradication and removal on their territory, that would be mandatory for local self-management units – municipalities and cities;
2. a meticulous action plan for ragweed eradication be made, and bearers of certain activities be identified, deadlines and financial resources set, and control and an evaluation of what has been done be carried out;
3. In the early phase, ragweed should be eliminated by uprooting the whole plant that is by mechanical means, primarily in the areas that are not extremely weed-choked, and that are harder to reach. This primarily applies to gardens, forest periphery and grassland around houses, and other minor green areas. At the earlier stage of a plant's development (4–6 leaves), which corresponds to a time span of 20–30 days since the day of plant's blossom in greater areas, ragweed can be treated chemically, by spraying herbicides based on the active ingredients of acetochlor, which are not that highly toxic. Chemical eradication is optimal for performance in great arable land, under cultures, or other areas without large presence of people. Ragweed should not in any way be treated by herbicides in water-protected areas, as well as on fruit and vegetables plantations, for there lays a danger of poisoning through air breathing, water or fruit;
4. in later stages ragweed should be eradicated mechanically, by uprooting or tearing in all phases of its growth before the seed matures, and by mowing grassland areas and other areas, plowing under the stubble and other familiar methods of weed elimination;
5. every single approach needs financial resources, that are fairly larger sums than what is now being invested into ragweed elimination.

Action plan for ragweed eradication has defined the bearers of activity (key shareholders) and the activities in the process of decreasing ragweed areas in Zagreb County. Key shareholders (participants) in the realization would be the following: the Government of the Republic of Croatia, Zagreb County and towns and municipalities in the area of Zagreb County, communal companies, water management, forest administrations, Croatian Railways, owners or lease-holders of land, hunting-grounds and other areas, ecological associations, scouts, schools, military, doctors and their patients, social care centers, all residents of the County and those of the adjoining county – the City of Zagreb.

The organizers of plan conduction are Zagreb County Administrative Department of Health Care and Social Welfare, towns and municipalities.

Acting parties in airborne pollen decrease caused by ragweed pollen will be: Administrative Department of Health Care and Social Welfare of Zagreb County, communal societies, public utility services, schools, ecological associations, scouts, social assistance users, people completing their military service (soldiers and people who are in noncombatant military service), volunteers, owners and leaseholders (users) of land, hunting grounds and the like.

A county team for health and Department for Health Care of Zagreb County, Zagreb Public Health Institute, competent bodies of units of local government and self-government would control the performance.

In order for the plan to be implemented successfully, there has to be cooperation among the counties, for airborne ragweed pollen does not stop at administrative borders of counties, or at that of the City of Zagreb. We believe that in order to achieve full success, ministries responsible, as well as the Government of Croatia, should participate in its realization.

Concrete actions, doers and time span would be determined through an annual activity plan.

The region of the City of Zagreb and Zagreb County is not the only one facing the problem of ragweed spreading, but this is a concern of a wider area of the counties in continental Croatia.

In the scope of postgraduate course in regular medical enhancement of the first category, with knowledge testing that was organized and conducted on behalf of the School of Public Health »Andrija Štampar», School of Medicine, University of Zagreb, and The Centers for Disease Control, Atlanta, USA, which goes by the name of Responsible Health Administration and Management Program, 15 counties completed an educational training, during which a county image of health was made, public health priorities defined, and intervention plans formed – with the aim of addressing selected public health priorities in their areas.

The counties of Osijek-Baranja, Bjelovar-Bilogora, Varaždin, Brod Posavina and Zagreb County have recognized the problem of ragweed as a significant public health problem, and have incorporated ragweed spread prevention among its priorities. The counties situated along the Adriatic Sea, Split-Dalmatia, Istra, Primorje – Gorski Kotar have not recognized the problem of ragweed as a public health problem, which is supported by the fact that ragweed is not widespread in those areas.

According to the list of selected priorities and measures taken, the problem of pollinosis caused by ragweed blossom is much more noticeable in continental counties than in those by the sea. Furthermore, depending on the funds, some of the continental counties and the City of Zagreb invest significant resources in ragweed eradica-

tion and resident education, while other continental counties either do not recognize ragweed as a public health problem or do not heave sufficient funds to deal with problems caused by ragweed effectively.

The counties of Varaždin, Međimurje, Požega-Slavonia, Virovitica-Podravina, Osijek-Baranja, Bjelovar-Bilogora, Zagreb and the City of Zagreb have elaborated measures of ragweed eradication and are putting into effect plans for ragweed eradication. In some counties (e.g. Zagreb County), the action of eradicating ragweed in nature is organized by the very county, while in others (e.g. Virovitica-Podravina County) ragweed eradication is conducted by competent authorities following the order of Ministry of agriculture, forestry and water management on taking measures for mandatory elimination of ragweed without the county having to pass a decree on ragweed eradication.

The counties of Koprivica-Križevci and Brod-Posavina have recognized the problem of ragweed allergies as a public health problem but are not carrying concrete action for its eradication.

The counties of Karlovac, Krapina-Zagorje, Vukovar-Srijem, Lika-Senj, and Sisak-Moslavina among the continental ones, and all of those along the Adriatic Sea, do not perform any action for ragweed eradication, and the very problem of ragweed allergies is not thought to be a public health problem. Afore said is not surprising, for ragweed pollen appears sporadically in the counties adjoining the sea, but it is symptomatic that above-mentioned continental counties do not recognize the problem of ragweed spread when it is known that their adjoining counties invest significant financial resources in its eradication, and they have systematic measures of ragweed eradication.

In the area of Zagreb County, ragweed prevails in the parts of Ivanić Grad Velika Gorica, even though it is present in the areas of all towns and municipalities in Zagreb County, as well as the City of Zagreb, while all types of areas have been registered as habitats of ragweed (water-courses, uncultivated agricultural land, alongside roads, plough-fields after harvesting etc.).

Since 2002, when systematic ragweed eradication in the area of Zagreb County started, public utility services of towns and municipalities, scouts, ecological associations, Red Cross Youth, as well as a number of legal entities and physical persons participate apart from Zagreb County itself.

Zagreb County and the City of Zagreb have most systematically approached the problem of ragweed spread, that is, its eradication so far. The goal set is to decrease the ragweed pollen grains concentrations to the minimum of 30 grains *per* m^3, because when ragweed pollen is below that level, it does not cause allergic discomfort in most allergic individuals. This goal determined is quite ambitious and almost utopian, moreover, knowing that not all of the counties have programs and projects, as well as decrees on mandatory eradication of ragweed, and ragweed pollen grains do not stop at administrative borders of the countries surrounding Croatia, nor do they stop at the borders of certain counties. There is no help whatsoever neither from the Ministry of Health and Social Welfare, nor from Croatian Institute for Health Insurance, and the same goes for financial help on behalf of Ministry of Agriculture, Forestry and Water Management. In its order on taking measures for obligatory eradication of ragweed, it has stated that the Ministry will ensure funds so that Plant Protection Department in Agriculture and Forestry of the Republic of Croatia, and Department of Herbology of the Faculty of Agriculture of Zagreb could observe the beginning and continuity of ragweed blossom, make an evaluation on the degree of weed overgrowth, establish how widespread it is in the Republic of Croatia, inform the public via the media on control measures and some other duties, but there is no financial help to those who are selected to eradicate ragweed.

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D. Gajnik

Zagreb County Institute of Public Health, Pavla Lončara 1, 10290 Zaprešić, Croatia
e-mail: davorin.gajnik@gmail.com

MJERE INTERVENCIJE KOD KONTROLE ŠIRENJA PELUDA AMBROZIJE (*AMBROSIA ARTEMISIIFOLIA* L.) NA PODRUČJU ZAGREBAČKE ŽUPANIJE I GRADA ZAGREBA

S A Ž E T A K

Povećana incidencija alergija na pelud ambrozije potaknula je neke zemlje sa velikim problemom zagađenja peludom ambrozije (Mađarska, Italija i Francuska) u razvijanju strategija za uništavanjem te korovne biljke. Svrha ovog rada bila je odrediti učestalost alergijskih bolesti uzrokovanih peludom ambrozije na području Zagreba i Zagrebačke županije u razdoblju od 2002.–2004. godine, kao i definirati akcijske planove za uništenje te korovne biljke. Zahvaljujući podacima analize uobičajenih metoda koje su se koristile u dosadašnjim akcijama uništavanja ambrozije došlo se do zaključka da bi se kombinacijom agrotehničkih, kemijskih, mehaničkih i administrativnih metoda, dakle primjenom mješovite metode uništavanja ambrozije, mogle znatno smanjiti površine zahvaćene ambrozijom, pa tako i smanjiti broj zrnaca peludi u zraku. Također vrlo veliki značaj u preveniranju simptoma ima i informiranje javnosti o vremenskoj i prostornoj raspodjeli peluda ambrozije u zraku. Na taj način osobe koje su alergične na tu vrstu peluda mogu prilagoditi svoje aktivnosti na način da što manje dolaze u kontakt s alergenom.