



Tree of heaven (*Ailanthus altissima*) pollen—a possible new source of sensitization in Central Europe

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To the editor

Climate change leads to changes in vegetation composition which are reflected in the pollen spectrum and subsequently in allergic rhinoconjunctivitis and allergic asthma. Either new plants (and pollen) appear or plants already present in an area become more abundant or disappear. Ragweed (e.g., *Ambrosia artemisiifolia*) is a well-known example of the spread of a non-native taxon with pollen relevant to allergy sufferers that has been naturalized in Europe for almost a century. Favored by climate change ragweed has spread over large parts of Central Europe during the last few decades. Ragweed pollen initiates sensitization and allergies—but initial sensitization to ragweed is hardly detectable in the population today after years of continued contact with the allergen.

A possible new source of an allergy-relevant pollen for Central Europe may be tree of heaven (*Ailanthus altissima*, *Simaroubaceae*). This tree is native to Asia, especially parts of China. Individual ornamental specimens were introduced to Germany several decades ago. Since then, this tree species has been spreading

invasively, so far predominantly in larger cities such as Berlin (Fig. 1).

The pollen of tree of heaven is mainly spread by insects but some pollen is also airborne, and in areas of origin, e.g., China, often leads to sensitization, allergic rhinitis, and asthma. In a joint study, we found a sensitization rate of approximately 30% in an examined population of 44,994 patients of all ages in Beijing, China [1]. In Berlin, Germany, the presence of male tree of heaven trees is already reflected in the airborne pollen spectrum [2, 3] and the allergological significance is documented by a positive nasal provocation test [4].

To date, one allergen (Ail a) is known as a major allergen [5, 6]. Positive skin prick test results with *A. altissima* have generally been found in polysensitized patients [7], probably due to cross-reactivity with other pollen taxa [7, 8] since *A. altissima* pollen contains cross-reactive calcium-binding proteins [9] and cross-reactive carbohydrate determinants (CCDs) [8] which have also been identified in pollen of unrelated species. Since the tree of heaven is now spreading in Europe, there is an opportunity to determine the current frequency of sensitization in order to follow the further development of sensitization in the coming years.

The current frequency of sensitization was studied in the German-speaking area of Central Europe (Germany, Switzerland, and Austria) from the results of the “igevia” allergy test (company Scientific DX GmbH, Vienna, Austria) from 2466 sera submitted and examined by the Allergy Explorer (ALEX 2) technique. The ALEX 2 is an ELISA-based in vitro multiplex allergy test allowing simultaneous measurement of total IgE (tIgE) and specific IgE (sIgE) against 295 allergen extracts and molecular allergens [10]. Among the 295 tested allergens are 58 pollen taxa (27 tree pollen taxa, 12 grass pollen taxa, 19 herb pollen taxa). In addition, clinically

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Fig. 1 A wild stand of young *Ailanthus altissima* trees in Berlin city center. © Matthias Werchan

irrelevant IgE antibodies against CCDs are automatically blocked. Individuals who have their blood serum tested are interested in finding out possible cause of the allergic symptoms. The individuals are not further characterized.

All findings are from the period February 2020 to January 2022. As shown in Fig. 2, very few individuals have so far been sensitized by pollen from tree of heaven. Of the 2466 sera tested, 12 (0.49%) showed positive results (radioallergosorbent test [RAST] ≥ 0.35 kUA/l) against specific IgE from *A. altissima*. The highest value was 5.85 kUA/l (Table 1). Eleven out of these 12 individuals also showed sensitization (RAST ≥ 0.35 kUA/l) to other unrelated pollen allergens such as Bet v 1 (8 times) and other pollen allergens from members of the Bet v 1 family (Cor a [10 times], Fag s 1 [9 times] Aln g 1 [7 times]) or tree pollen allergens of ash (Fra e 1 [5 times]) and cypress (Cup a 1 [7 times]). Ten of these 12 individuals showed sensitization to the grass pollen allergen Phl p 5. In contrast, sensitizations to herb pollen allergens of

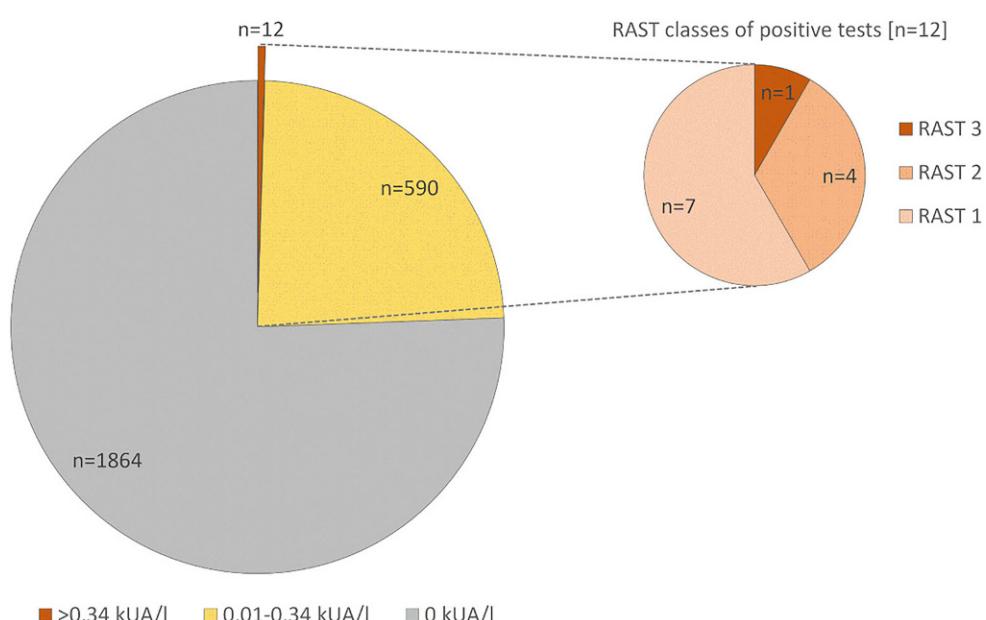
Table 1 Comparison of the 12 positive radioallergosorbent test (RAST) results for specific IgE of *Ailanthus altissima* with different indicators for IgE-mediated cross-reactions (profilin and polcalcin). All positive RAST results are shown in *italics*

Probe number	Ail a (kUA/l)	Bet v 2 (kUA/l)	Phl p 12 (kUA/l)	Phl p 7 (kUA/l)
	Profilin	Profilin	Polcalcin	
1	<i>5.85</i>	<i>0.83</i>	<i>2.04</i>	0
2	<i>2.69</i>	0	0	0
3	<i>1.38</i>	0.09	0	0
4	<i>0.96</i>	<i>33.38</i>	<i>28.76</i>	0
5	<i>0.93</i>	<i>13.32</i>	<i>9.83</i>	0
6	<i>0.65</i>	0.06	0	0
7	<i>0.58</i>	0	0	0
8	<i>0.47</i>	0.2	0.07	0.03
9	<i>0.41</i>	<i>3.36</i>	<i>3.81</i>	0.3
10	<i>0.41</i>	0	0	0
11	<i>0.38</i>	0.02	0	0
12	<i>0.36</i>	0.12	0	0

mugwort and ragweed were almost nonexistent: Amb a 1 (1 times) and Art v 1 (0 times). When looking for IgE-mediated cross-reactions to pan-allergens such as profilin and polcalcin [11], 4 of the 12 individuals showed sensitization to profilin (Bet v 2 and Phl p 12) in addition to positive reactions to the specific allergen of *A. altissima*, but none of the individuals showed sensitization to polcalcin (Phl p 7), as shown in Table 1. It may therefore be assumed that pan-allergens play some, but not the decisive role in sensitization to *A. altissima*.

A limitation of our investigation is undoubtedly the lack of further allergological characteristics of the individuals who sent blood samples to the laboratory in Vienna. Nevertheless, the value of this small study and

Fig. 2 *Ail a* allergen sensitization results for 2466 sera for the period February 2020 to January 2022. The left circle represents the proportion of positive radioallergosorbent test (RAST; ≥ 0.35 kUA/l) compared to the total number of tests ($n=2466$). The right circle represents the RAST classes of the 12 individuals with positive test results. RAST 1 = 0.35–0.70 kUA/l, RAST 2 = 0.70–3.50 kUA/l, RAST 3 = 3.50–17.5 kUA/l



the technique used may lie in being able to observe future developments in the frequency of sensitization to this new allergen in Central Europe.

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Conflict of interest M. Werchan, D. Flener and K.-C. Bergmann declare that they have no competing interests.

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