

Does cutting of mugwort stands affect airborne pollen concentrations?

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Pollen of mugwort (*Artemisia vulgaris* L.) is the most important allergenic pollen in urban areas of south and central Finland in late summer. The purpose of this study was to investigate, experimentally, whether the cutting of mugwort stands affects its airborne pollen concentrations. Experimental plots were either cut (4 plots) or uncut (4 plots) in 2 previous seasons: 4 of them were small (<0.5 hectare) and 4 large (>5 hectares). Finally, the plots were divided randomly into 2 groups according to a third variable, cutting in the study season, 1989. Samples were taken on 2 rainless mornings at the peak mugwort flowering time. Two rotorod type samplers were used at heights of 1 and 2 m from ground level, simulating the inhalation heights of children and adults, respectively. The results indicate that cutting mugwort stands significantly reduces airborne pollen concentrations, but the treated areas have to be large, since in the town area there are plenty of mugwort pollen sources. The pollen concentrations at the 2 heights tested did not differ significantly.

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The pollen of mugwort (*Artemisia vulgaris* L.) is the most important allergenic pollen in Finland in late summer (July–August). A second flowering (1) in September prolongs allergic symptoms in southern Finland in warm summers.

Mugwort is an abundant weed on road sides, backyards and waste lands in urban areas in south and central Finland. Due to abundant seed production and effective dispersal by birds and trade of garden soil, it is capable of quickly colonizing patches of disrupted ground. Once established, mugwort stands survive for several years on a strong root system. The stands are often dense and large monocultures of several hectares, individual plants reaching up to 1.5 m in height. Unlike most plants of the order Asteraceae, mugwort is anemophilous (wind-pollinated).

Knowing that mugwort pollen does not disperse over long distances (7), one could assume it reasonable to control mugwort stands in residential and recreational areas. The use of herbicides against mugwort is inconsistent with the aim of creating a healthier environment. Rooting up young shoots early in the season can be used only locally. Mechanical cutting of the stands thus seems to be the only realistic method in the large-scale elimination of mugwort stands.

The idea of total elimination of the plant from the city area was suggested to Departments of Environment in Turku city by the Association for the Pul-

monary Disabled (the members are patients and their relatives) of the Turku region. Since then the mugwort stands of the Turku town area have been mapped, and during recent years some large mugwort areas have been cut.

The purpose of this study was to investigate, experimentally, whether the cutting of mugwort stands affects its airborne pollen concentrations.

Material and methods

Study sites

Eight experimental plots, with extensive and uniform mugwort stands, were chosen in May 1989. The plots differ with respect to 2 treatments, each at 2 levels: they were either cut (C) or uncut (U) in 2 previous seasons, 1987–88, and either small (S, <0.5 hectare) or large (L, >5 hectares). Finally, the plots were divided randomly into 2 groups according to a third aspect, cutting in the study season, 1989. In addition, 2 plots, one in the middle of a golf course and another in a sugar beet field, were chosen to represent areas completely free of mugwort (Table 1).

Methods of sampling and analysis

Two rotorod type pollen samplers (6) were attached to a pole in the centre of each plot. In the plots cut in 1989 the poles were 19 to 65 m from the nearest

Table 1. Distance from nearest mugwort plant to study site, treatment of study site in 1989 (C=cut, U=uncut, CR=control), treatment of study site during 1987–88, size of study area (S<0.5 hectare, L>5 hectares) and mean and maximum concentrations on each study site

Study site	Distance (m)	Treatment		Size	Mean (p.g. m ⁻³)	Max (p.g. m ⁻³)
		1989	1987–88			
1	24	C	C	S	109	671
2	65	C	C	L	46	204
3	2	U	C	L	58	171
4	2	U	C	S	56	242
5	19	C	U	S	91	528
6	30	C	U	L	13	55
7	2	U	U	L	1088	3762
8	2	U	U	S	325	621
9	94	CR			1	6
10	91	CR			43	154

individual mugwort (Table 1). The samplers were at heights of 1 and 2 m, simulating the inhalation heights of children and adults, respectively. Each sampler had 2 collecting rods, with a piece of tape made sticky with a toluol solution of paraffin and vaseline. The rotation speed of the collecting rods was adjusted to 2000 rpm, as recommended by the manufacturer.

Sampling was planned to take place on two rainless mornings between 20th and 30th of July, the peak flowering time in Turku (1). The actual dates were the 24th and 26th of July. The data for the 26th of July were lost for one study site (small, never cut) due to incorrect operation of the sampler. Four half-hour sample periods, from 08:30 to 11:15 a.m. with 15-min intervals, were used to cover the diurnal peak of pollen production (1, 4, 7). The samples were carried into the laboratory in sterile petri dishes, and after mounting in lactic acid, the mugwort pollen grains were counted microscopically on a 0.35 mm wide transect totalling 6.65 mm²/slide.

The pollen number obtained is proportional to the pollen concentration in the air. To calculate rotorod pollen counts to correspond pollen concentrations in a m³ of air, a 7-day Burkard trap (Burkard Manufacturing Co.) was located at one study site next to the rotorod samplers. The Burkard samples were analysed according to the random analysing method described by Mäkinen (5).

Statistical analyses

Logarithmic transformation, $\log(x + 1)$, was applied to the data to minimize the correlation between the mean and the variance. The daily means for each study site were calculated separately for each height. In the statistical analyses, the GLM (general linear model) and REG (linear regression) procedures of the SAS statistical package for microcomputers (9) were used.

Results

Pollen counts from the 2 sampling heights did not differ significantly either in the data as a whole or in separate analyses by study sites, although they were consistently higher close to the ground (6 of 8 cases). The corresponding mean concentrations were 199 and 176 pollen grains/m³ of air at 1 and 2 m, respectively. The pollen concentration grows slightly more slowly at 2 m (Fig. 1). Hereafter, only measurements taken at a height of 2 m are considered.

The pollen counts at 2 m on the 2 sampling dates did not differ significantly either in the data as a whole or in separate analyses by study sites. The corresponding mean concentrations were 206 and 143 pollen grains/m³ of air on the 24th and 26th of July, respectively. As there was only a difference in 4 out of 7 by sites, the data for both dates were pooled for the final analysis, and it was concluded that the loss of data for one study site on the second sampling date was not likely to cause a serious bias.

According to the analysis of variance, cutting in the study season and cutting in previous seasons had a significant effect on the pollen counts, whereas the third main variable, size of plot, was not significant. The only significant interaction was that between cutting in the study season and plot size. The mean pollen counts for the groups showing significant effects were compared *a posteriori* by the Student-Newman-Keuls test (Figs. 2–3).

The study plots which had been cut once, either in the study season or earlier, did not differ from each other, nor did they differ from plots which had been cut in all 3 years. Plots that had never been cut had significantly higher pollen concentrations (Fig. 2). As far as cutting and plot size are concerned, there is no significant difference between

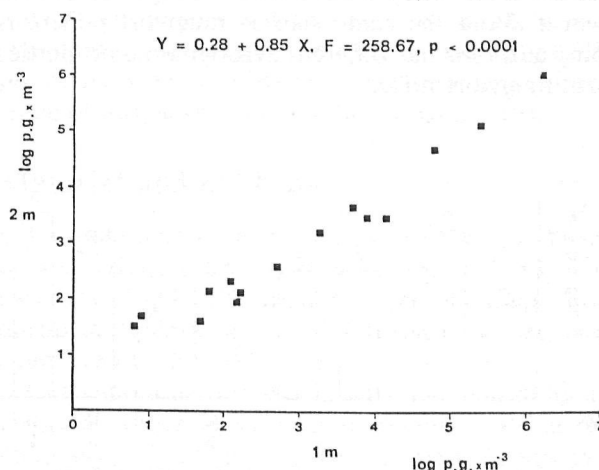


Fig. 1. Relationship between pollen counts at heights of 1 and 2 m. Each square represents a daily mean for one study site ($n = 15$). Log-transformed data.

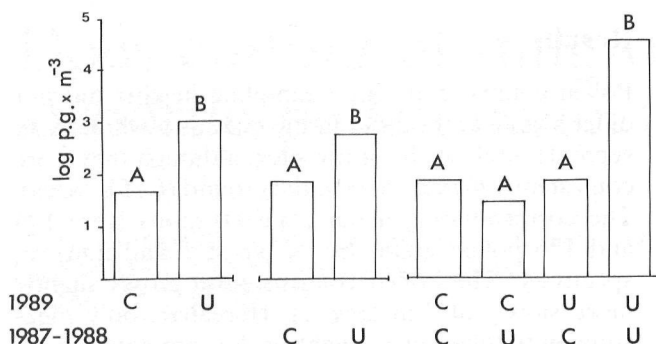


Fig. 2. Comparison of means by Student-Newman-Keuls test. Cutting in 1989 and 1987-1988 and their interaction. Means with same letter (A/B) are not significantly different. (C = cut; U = uncut).

small cut and uncut plots. In large plots, however, there is a significant difference between cut and uncut plots (Fig. 3).

In the control areas, the golf course and the sugar beet field, the pollen concentrations were close to zero (Table 1).

Discussion

Our results indicate that the pollen concentrations at the inhalation height of adults and children are practically the same. On the other hand, we know that mugwort pollen concentrations at ground level are 10-fold compared to those at roof level where pollen traps are usually placed for long-term monitoring purposes (7). Dilution evidently takes place quite rapidly above the height of the highest shoots, and mugwort pollen does not disperse to any appreciable degree in the upper air layers. Raynor et al. (8) showed that the pollen concentrations of ragweed (*Ambrosia* L.), which is closely related to mugwort, did not change between 1.5-180 m from the ground. In that study, the ragweed pollen sources were distant from the study sites. However, ragweed pollen, even if about the same size as mugwort pollen, is spiny and thus has different aerodynamic properties from mugwort pollen.

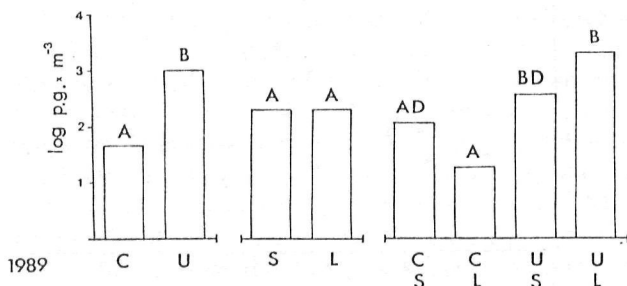


Fig. 3. Comparison of means of Student-Newman-Keuls test. Cutting in 1989, plot size and their interaction. Means with same letter (A/B/D) are not significantly different. (C = cut, U = uncut; S = small (<0.5 hectare); L = large (>5 hectares)).

Cutting mugwort stands appears to significantly reduce airborne pollen concentrations. In addition, the effects can be detected already after the first season. Cutting small areas is logically not as effective as cutting large stands. This is due to the side effect of nearby mugwort stands and their short-distance wind dispersal. Cutting large areas (e.g. waste lands, dumping grounds) has important consequences in 2 ways: 1) it decreases local pollen concentrations in the air and, 2) it depresses mugwort dispersion to other areas.

Rotorod samplers are convenient in studies with several simultaneous sampling operations. When accumulators are used, no electric current is needed and samplers may be run in field conditions without changes in rotating speed. Rotorod samplers are also effective for the size class of pollen grains (3).

The long-term effects of cutting mugwort stands have not been studied and cannot be predicted. Cutting could even increase the development of new shoots; plants might remain smaller, but there might be no difference in pollen and seed production. The individual plant should be cut close to the ground; otherwise the remaining assimilating parts could soon increase the vitality of the plant. The only effective method of removing mugwort stands may be to uproot the whole plant by hand.

In Finland there are no other plants with allergenic pollen to which this model could be applied, but on a world scale similar problems arise, at least with plants of the same family, especially in the genus *Ambrosia* (2).

Acknowledgement

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References

1. Finnish Pollen Bulletin. Vol. 9-14 Suppl., The Finnish Aerobiology Group, University of Turku, 1984-1989.
2. FISHBACH FA. Biophysical factors in ragweed pollen. Avoidance strategies in a community. *Grana* 1986; 25: 221-33.
3. GREGORY PH. The microbiology of the atmosphere, 2nd edn. Aylesbury: Leonard Hill, 1973: 141.
4. KÄPYLÄ M. Diurnal variation of non-arboreal pollen in the air in Finland. *Grana* 1981; 20: 55-9.
5. MÄKINEN, Y. Random sampling in the study of microscopic slides. *Rep Aerobiol Lab Univ Turku* 1981; 5: 27-43.
6. PERKINS WA, LEIGHTON PA. The rotorod sampler. 2nd semi-annual rep. Stanford Univ: Aerosol Lab., CML 186, 1957.
7. RANTIO-LEHTIMÄKI A, KOIVIKKO A, KUPIAS R, MÄKINEN Y, POHJOLA A. Significance of sampling height of airborne particles for aerobiological information. *Allergy* 1991; 46: 68-76.
8. RAYNOR GS, OGDEN EC, HAYES JV. Variation in ragweed pollen concentration to a height of 108 meters. *J Allergy Clin Immunol* 1973; 51: 199-207.
9. SAS User's Guide: Statistics. 5th edn. Cary, NC: SAS Institute, 1985.

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