



CASE STUDY

Occupational asthma caused by *Arabidopsis thaliana*: a case of laboratory plant allergy

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ABSTRACT: A 36-yr-old male never-smoker with an 8-yr history of hay fever but no past history of asthma undertook a 3-yr research project involving the plant *Arabidopsis thaliana*.

The subject was based in a small laboratory with an attached growing room. After 30 months of research, he began to develop breathlessness within 5–10 min of entering the laboratory.

Initial investigations confirmed asthma with airflow obstruction (forced expiratory volume in one second (FEV₁)/forced vital capacity was 3.01/4.75 L; predicted values were 3.67/4.43 L) and increased airway responsiveness. Serial peak expiratory flow measurements showed a work-related pattern. A supervised workplace challenge test led to a fall in FEV₁ from the baseline value of 3.10 L to 1.95 L within 20 min of entering the growing room. Skin-prick solutions were prepared from *Arabidopsis* leaves and flower heads; positive 4-mm responses were obtained to the flower heads (i.e. to the pollen).

Arabidopsis is a member of the Brassicaceae family. It is used extensively in plant biology research as its genome is small, has been fully sequenced and is easily manipulated. The present article represents the first reported case of occupational asthma due to *Arabidopsis thaliana*.

KEYWORDS: *Arabidopsis*, asthma, occupational lung disease, plant allergy

A 36-yr-old male postgraduate student presented with a 3-month history of breathlessness, wheeze and cough. His only past medical history was of hay fever for 8 yrs. He took no regular medication and was a lifelong nonsmoker.

He had studied the plant *Arabidopsis thaliana* for 30 months and had spent much of his time in a growing room that measured $\sim 4 \times 3 \times 3$ m. The room was maintained at 22–24°C and 30–55% humidity. It had no specific ventilation, but it was not obviously damp or mouldy. *Arabidopsis* plants were grown to flowering stage and it is likely that pollen was present in the room. The subject reported that respiratory symptoms started within a few minutes of entering the growing room. The subject suffered only mild symptoms at other times, but typically he felt better at weekends.

Initial investigations revealed mild airflow obstruction with forced expiratory volume in one second (FEV₁)/forced vital capacity (FVC) of 3.10/4.75 L (predicted values were 3.67/4.43 L).

Skin-prick tests showed 4-mm responses to mixed grass pollen, rapeseed pollen and house dust mite. Airway responsiveness to methacholine was within the asthma range, with a provocative dose causing a 20% fall in FEV₁ of 22 µg [1]. The peripheral blood eosinophil count was not raised. Serial peak expiratory flow measurements (fig. 1) showed a strongly work-related pattern, with an OASYS-2 score of 4 [2]. OASYS-2 is a computer program that plots and interprets serial peak expiratory flow readings using discriminant analysis to score the probability of occupational asthma between 1 and 4. Scores >2.5 have 94% specificity for occupational asthma and 75% sensitivity. Skin-prick tests with solutions prepared from the flowers and leaves of *Arabidopsis* showed positive responses to the flower only.

A physician-supervised workplace challenge resulted in a rapid fall in FEV₁ from 3.1–1.95 L over 20 min with subsequent spontaneous recovery to 3.1 L (fig. 2).

Fortunately, the student was nearing the end of his research and he was easily able to avoid

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STATEMENT OF INTEREST

None declared.

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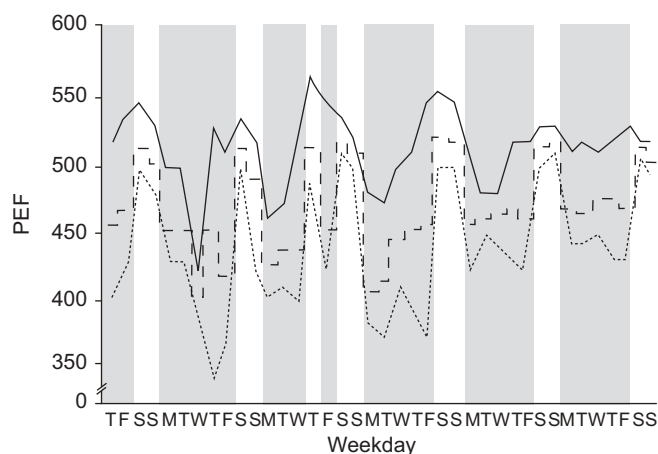


FIGURE 1. OASYS-2 plot showing serial peak expiratory flow (PEF) readings. Days of the week are represented by their initial letters. ■: days at work; —: daily maximum; - - -: daily mean; and: daily minimum PEF readings.

further exposures to *Arabidopsis*. After 6 months, he felt symptomatically much better, although he still had evidence of mild asthma with intermittent wheezing and reduced lung function, with FEV₁ and FVC of 2.8 L and 4.46 L, respectively. Methacholine testing was not repeated.

DISCUSSION

A. thaliana is a small brassica plant that is of no economic importance but lends itself to research because of its rapid life cycle and nonfastidious nature [3]. It is regarded as the most important plant model for genetic engineering research. The current authors believe that they have described herein the first case of type I hypersensitivity and occupational asthma caused by *Arabidopsis*.

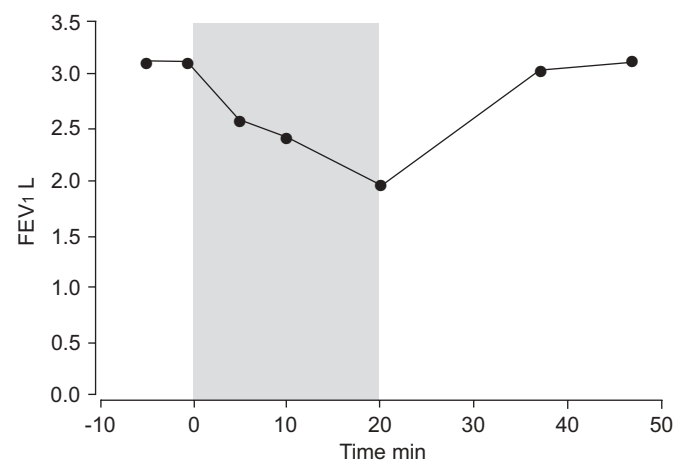


FIGURE 2. Graph showing changes in forced expiratory volume in one second (FEV₁) readings before, during (■) and after exposure to *Arabidopsis* plants in the growing room.

Other Brassicaceae species, particularly rapeseed, are recognised as important allergens, and rapeseed has previously been described as a cause of occupational asthma [4]. The subject of the present study had a positive skin-prick test to rapeseed, which was probably a cross-reaction with *Arabidopsis* as he had no relevant symptoms. Serum from patients with rapeseed allergy has previously been reported to cross-react with *Arabidopsis* [5].

Several of the allergenic proteins of rapeseed, including berberine bridge protein, a receptor-like protein kinase, and the cobalamin-independent methionine synthetase [6], are also found in *Arabidopsis*. Cross-reactivity has also been shown between *Arabidopsis* germin-like proteins and serum from patients with birch, grass and mugwort allergy [7]. These findings suggest routes to improved understanding of common inhalant allergies, as the genome of *Arabidopsis* has been fully sequenced and can be easily modified.

Arabidopsis is widely used in plant biology studies and appears to have considerable allergenic potential; it is perhaps surprising that no cases of occupational asthma have been described previously. Laboratory animal allergy is common and has been well described [8], but laboratory plant allergies are much less frequently reported and may be under-recognised. Continued vigilance with this and other potential causes of occupational asthma is necessary.

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