Silver Birch (*Betula pendula*) Pollen and Human Health: Problems for an Exotic Tree in New Zealand

Ian F. Spellerberg, Nils E. Eriksson, and Vincent St. A. Crump

Abstract. Silver birch (*Betula pendula*) is commonly used as a street tree in temperate climatic regions. However, the medical literature contains a wealth of reports on the health effects of pollen from silver birch. In many countries such as New Zealand, silver birch is the main tree that causes allergic symptoms, including seasonal hayfever, asthma, and other health conditions such as food allergies (the oral allergy syndrome). Exposure to pollen from silver birch is more likely to occur in cities because of the numbers of the trees and the human population density. Even if there were doubts about the extent of the problem and the costs associated with the problem, the precautionary principle should apply. The health-related problems of silver birch should be promulgated and trees should be removed.

Key Words. Allergies; human health problems; silver birch pollen.

In the arboriculture literature, there are many articles that include lists of trees that are suitable for urban environments. Similarly, in the research literature, there are many papers that deal with selection of trees for urban environments (see for example Ware 1994; Kristoffersen 1999; Saebo et al. 2003). There are many factors to consider, including suitability of the site, aesthetic and design factors, and nuisance factors. Nuisance factors include propensity to drop limbs, shed bark, have unpleasant odors, and have poisonous properties.

The fact that some plants and plant pollen cause allergies (allergenic) has been known for some time. Indeed, there are some species such as privet (*Ligustrum* spp.) and ragweed or mugwort (*Ambrosia* spp.) and, more recently, olive (*Olea europaea*) that pose allergy-related problems worldwide and are troublesome for agriculture (Baldo et al. 1992; Wickens 2001). Some plant species that cause allergies are so widespread that it is difficult to eradicate them. However, some species of trees that are introduced species may be much more manageable by way of some eradication and by education. Allergy-free gardening has been addressed by several authors such as Ogren (2000). However, management of plants that cause allergies may have to be modified country by country because of local conditions.

Silver birch (*Betula pendula*) is native to Europe and Asia Minor. It has been introduced to Australia and New Zealand. Ecologically, silver birch is a fast-growing and short-lived species. It has male catkins on the ends of small shoots, visible all winter. The female flowers are typically on branched stalks and some appear at the base of the male catkins. The pollen is dispersed by wind over several weeks in the summer. The pollen can be spread over considerable distances, and in our experience (Sven-Olov Strandhede, pers. comm.) in Europe, the pollen can even cross the Baltic Sea.

In temperate climatic regions, silver birch is, with few exceptions, considered to be a suitable species as a street tree. Many authors extol its universal appeal as an ornamental tree suitable for private gardens and streets and parks. The main reasons for its popularity include its whitish/silver-colored bark, graceful form, and autumn colors. However, some civic authorities (e.g., Palmerston North, New Zealand) list silver birch as being unsuitable because of the seeds and the roots.

In New Zealand, pollen from introduced species is a common cause of hayfever and asthma. A major contributor is the pollen from perennial rye grass. Among tree species, the pollen from pines has not been found to be a problem. Of all introduced species in New Zealand, the introduced silver birch is the main problem.

The health-related problems of silver birch pollen, although well documented in the medical literature, appear not to have reached arboriculture literature or landscape architecture literature. Conversations with arboriculturalists and landscape architects have confirmed this conclusion. The purpose of this article is therefore to promulgate the issue and prompt discussion.

METHODS

While undertaking research on the criteria used to select trees for urban environments, the health problems caused by silver birch pollen were noted in the medical literature. Consequently, a detailed review of the medical literature was undertaken and this was supplemented with discussions with medical researchers, arboriculturalists, and landscape architects.

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RESULTS

Pollinosis and Asthma

Tree pollens are among the most important allergen sources. Silver birch and some related tree species have been described as the most potent and frequent allergen sources (Mothes et al. 2004; Mothes and Valenta 2004). This has been recorded in the literature for many years. Birch pollen is well known to be a significant aeroallergen (an allergen dispersed by wind). This pollen is known to be a notable cause of hayfever and pollen-related asthma (see for example Emberlin et al. 2003).

In New Zealand, birch pollen is the most common tree pollen causing seasonal rhinitis (see the Glossary for definitions of medical terms) together with food allergy (the oral allergy syndrome). The incidence of cases is increasing. Ten years ago at the Auckland Allergy Clinic, one or two patients a year with food allergy were being seen and now it is approximately 100 per year.

In Northern Europe, between 39% and 78% of atopic patients are sensitized against birch pollen (Eriksson et al. 1998), and in northwest Spain, between 13% and 60% of individuals who are immunosensitive to pollen grains respond positively to its allergens (Cotos-Yanez et al. 2004). In Vienna, more than 25% of the population have allergies caused by pollen from trees, including birch (Mothes and Valenta 2004). In some countries, the birch pollen allergy is increasing. In Belgium, for example, among patients with respiratory allergy, the frequency of birch pollen sensitization increased significantly from 13% in 1975 to 1979 to 34% in 1992 to 1995 (Stevens et al. 2003).

Although sensitization to pollen from other tree species does occur, an allergy against such trees is seldom found in the absence of birch pollen allergy. This has been found to be the case in Sweden where silver birch is common (Eriksson et al. 1984; Eriksson and Wihl 1987).

Exposure to birch pollen has implications for babies and young children. Exposure to high levels of birch pollen in infancy increases the risk of sensitization to the same allergen as well as the risk of asthma (Kihlstrom et al. 2002). Early pollen contacts, particularly during the first 6 months of life, increase the risk of pollen allergies for a period of 20 years (Bjorksten et al. 1980). It has also been shown that exposure of the mother during pregnancy to high levels of birch pollen results in a tendency toward increased risk of sensitization to the same allergen and symptoms of atopic disease in children (Kihlstrom et al. 2003). So significant are the effects of birch pollen on health that there has been research on shifts in the timing of the birch pollen season (Emberlin et al. 2002).

Although birch pollen allergens have been implicated as asthma triggers, it appeared for some time that the pollen grains were too large to reach the lower airways where asthmatic reactions occur. However, research has shown that when the highly allergenic birch trees are flowering and exposed to moisture followed by drying winds, they can produce particulate aerosols containing pollen allergens (Taylor et al. 2004).

Food Allergies (adverse reactions to food) and Crossreactivity Between Food and Pollen

Crossreactions between food and aeroallergens occur as a result of common allergenic structures, epitopes, on the protein molecules. One of the most well-known crossreactions is that between birch pollen and a variety of vegetable foods. The foods that most often give symptoms in patients with birch pollen allergies are nuts (hazelnut, brazil nut, and walnut), kiwifruit, and also fruits belonging to the botanical family Rosaceae (apple, peach, almond, pear, nectarine, plum, cherry, apricot), as well as carrots, celery, and potato peel (Eriksson 1978; Eriksson et al. 1982; Ortolani et al. 1988; Anhoej et al. 2001; Eriksson et al. 2003; Ghunaim et al. 2005; Osterballe et al. 2005).

Approximately 70% of individuals with birch pollen allergies have symptoms of crossreactions to food (Eriksson et al. 1982). There is a positive relationship between the degree of birch pollen sensitization and the occurrence of food hypersensitivity; the more pronounced the birch pollen allergy, the greater the probability for the food allergy. Among those with the highest degree of sensitization to birch pollen, 90% report a food allergy (Eriksson et al. 1982).

In New Zealand, previous studies have shown that patients who are sensitized to birch pollen will develop symptoms (Crump, pers. obs.). Recently, for example, at the Auckland Allergy Clinic, 64 patients attending the clinic for immunotherapy for hayfever were interviewed followed by skin prick tests to fresh kiwi fruit, apple, and banana. Nine of those patients had known food allergy and of those, eight were allergic to silver birch. From the skin prick tests on the 64 patients, 37 patients were sensitized (21 to kiwi fruit, 10 to apples, and 6 to bananas).

In Northern Europe, allergy against crossreacting food is more common in patients with a "pan pollen allergy" (i.e., sensitization against grasses, mug wort [*Artemisia vulgaris*], and birch) than those with only a monopollen allergy or a combination of grass plus birch, grass plus mug wort, or birch plus mug wort pollen allergy (Ghunaim et al. 2005; Osterballe et al. 2005).

The kiwi fruit is one of the fruits that crossreact with birch pollen (Aleman et al. 2004). In the last few decades, the prevalence of the kiwi allergy is increasing in some European countries and was ranked among the top 10 foods among individuals with food allergies in Sweden, Denmark, and Estonia (Eriksson et al. 2004). Among patients with birch pollen allergies with crossreactive food allergy, 51% reported symptoms on eating kiwi fruit (Eriksson et al. 2003). The sensitivity can be so pronounced that symptoms can appear

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after kissing a person who has eaten a kiwi fruit (Mancuso and Berdondini 2001).

The symptoms most often induced by crossreacting food are oral symptoms such as itching of the lips, mouth, or pharynx and swelling of the lips, tongue, throat, and palate (known as the oral allergy syndrome [OAS]). Urticaria and more severe symptoms can, however, also occur (Ortolani et al. 1988). Birch pollen-related food may induce immediate or late eczematous reactions in children as well as in adults having atopic eczema (Reekers et al. 1999; Breuer et al. 2004). It seems that birch pollen can also give an intestinal inflammation. A significant increase of gastrointestinal symptoms was found in adults (with birch pollen allergy and a history of rhinitis) during the birch pollen season (Magnusson et al. 2003).

DISCUSSION

There is substantive evidence in the medical research literature to show that tree pollen of certain species is a significant cause of hayfever and asthma. This is particularly so in urban environments. Although pollen from other tree species such as acacia (Pumhirun et al. 1997), Japanese cedar (Nakagawa et al. 1996), Arizona cypress (Charpin et al. 2005), and olive (Geller-Bernstein et al. 1994) also are known to cause asthma and hayfever, in this article, we are dealing with birch, which has been shown to be a major cause of pollen allergy in some countries. Furthermore, although patients with an allergy to pollen from oak, the beech family (Fagaceae), alder, and hornbeam have been found to have a monoallergy to these trees, they also always have birch allergy.

There is substantive evidence in the medical research literature to show that birch tree pollen is a significant cause of seasonal hayfever and asthma. This is particularly so in urban environments. Compared with other tree species in New Zealand, silver birch pollen is the major cause of hayfever and asthma. Another potential threat is the increase in the number of olive trees in New Zealand. However, olive groves are not planted in urban areas and therefore are not likely to become as great a problem as birch trees. Silver birch pollen is also linked to allergic reactions to some food.

Measures suggested for avoidance of problems related to allergenic trees include avoiding planting new trees, especially near human population centers, and agronomic research for hypoallergenic trees (Charpin et al. 2005). In Europe, the silver birch is a native species and therefore it is not practical to consider removal of the trees. Avoidance of pollen is difficult, but there are some measures that can be taken. For example, making use of pollen counts, staying indoors, and the use of protective sunglasses may help.

Silver birch has commonly been used as a street tree in many cities, including New Zealand. This practice continues in major cities such as Auckland and Christchurch as well as in neighboring and recently established towns. For example, in Rolleston (a new and rapidly expanding town south of Christchurch), silver birch has been planted along the main streets. There is anecdotal evidence of increased numbers of patients with allergy symptoms being referred from the Rolleston area (Spellerberg, pers. obs.).

In general, the extent of the birch pollen health problems, the medical costs, costs to individuals and their families seems not to have been calculated. Even if there were any doubts about the extent of the issue, the precautionary principle must surely apply. Planting tree species that contribute to health problems should be avoided. At the very least, the costs of removal of existing birch trees should be weighed against the medical costs and other costs incurred by allergy sufferers.

In view of the findings of the research in the medical literature, there appears to be a growing health problem caused by birch pollen in urban environments or where groups of trees have been planted in locations where many people aggregate for work or other activities.

With regard to birch trees on public land, we suggest that councils should consider the following:

- Prepare an education program and promulgate the health issues;
- Introduce a policy of not using silver birch as a street tree or amenity tree; and
- In countries where silver birch is an introduced species, gradually remove existing silver birch trees from public places.

Implications for Arboriculture

Arboriculturalists should be aware of nuisance factors of trees and particularly those that cause health problems. This is particularly important for those trees used in city and urban environments. We believe that the human health problems caused by the pollen of silver birch are not well known among arboriculturalists or landscape architects in New Zealand and possibly elsewhere.

Glossary

These definitions are taken from Johansson, S.G. & Bieber, et al. 2004. Revised nomenclature for allergy for global use: Report of the Nomenclature Review Committee of the World Allergy Organization, October 2003. Journal of Allergy and Clinical Immunology 113:832–836.

Allergen: an antigen causing allergic disease.

Allergy: a hypersensitivity reaction initiated by specific immunologic mechanisms.

Atopic disease: disease of atopy, e.g., allergic asthma or rhinitis.

Atopy: a personal and/or familial tendency, usually in childhood or adolescence, to become sensitized and produce IgE antibodies in response to ordinary exposures to

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allergens, usually proteins. As a consequence, these persons can develop typical symptoms of asthma, rhinoconjunctivitis, or eczema.

Pollinosis: seasonal allergic rhinitis (hayfever) excited by the pollen of plants.

Rhinitis: hypersensitivity symptoms from the nose, e.g., itching, sneezing, increased secretion, and blockage. When immunologically mediated, it is called allergic rhinitis.

LITERATURE CITED

Aleman, A., J. Sastre, S. Quirce, M. de las Heras, J. Carnes, E. Fernandez-Caldas, C. Pastor, B. Blazquez, F. Vivanco, and J. Cuesta-Herranz. 2004. Allergy to kiwi: a double-blind, placebo-controlled food challenge study in patients from a birch-free area. Journal of Allergy and Clinical Immunology 113:543–550.

Anhoej, C., V. Backer, and H. Nolte. 2001. Diagnostic evaluation of grass- and birch-allergic patients with oral allergy syndrome. Allergy 56:548–552.

Baldo, B.A., R.C. Panzani, D. Bass, and R. Zerboni. 1992. Olive (*Loea europaea*) and private (*Lingustrum vulgare*) pollen allergens. Identification and cross-reactivity pollen proteins. Molecular Immunology 29:1209–1218.

Bjorksten, F., I. Suoniemi, and V. Koski. 1980. Neonatal birch-pollen contact and subsequent allergy to birch pollen. Clinical Allergy 10:585–591.

Breuer, K., A. Wulf, A. Constien, D. Tetau, A. Kapp, and T. Werfel. 2004. Birch pollen-related food as a provocation factor of allergic symptoms in children with atopic eczema/dermatitis syndrome. Allergy 59:988–994.

Charpin, D., M. Calleja, C. Lahoz, C. Pichot, and Y. Waisel. 2005. Allergy to cypress pollen. Allergy 60:293–301.

Cotos-Yanez, T.R., F.J. Rodriguez-Rajo, and M.V. Jato. 2004. Short-term prediction of Betula airborne pollen concentration in Vigo (NW Spain) using logistic additive models and partially linear models. International Journal of Biometeorology 48:179–185.

Emberlin, J., M. Detandt, R. Gehrig, S. Jaeger, N. Norlard, and A. Rantio-Lehtimaki. 2002. Responses in the start of *Betula* (birch) pollen seasons to recent changes in spring temperatures across Europe. International Journal of Biometeorology 46:159–170.

Emberlin, J., M. Detandt, R. Gehrig, S. Jaeger, N. Nolard, and A. Rantio-Lehtimaki. 2003. Responses in the start of *Betula* (birch) pollen seasons to recent changes in spring temperatures across Europe. International Journal of Biometeorology 47:113–115.

Eriksson, N.E. 1978. Food sensitivity reported by patients with asthma and hay fever. A relationship between food sensitivity and birch pollen-allergy and between food sensitivity and acetylsalicylic acid intolerance. Allergy 33: 189–196.

Eriksson, N.E., and J.A. Wihl. 1987. Tree pollen allergy. III. Cross reactions based on results from skin prick tests and the RAST in hay fever patients. A multi-centre study. Allergy 42:205–214.

Eriksson, N.E., H. Formgren, and E. Svenonius. 1982. Food hypersensitivity in patients with pollen allergy. Allergy 37:437–443.

Eriksson, N.E., S. Werner, and T. Foucard. 2003. Self-reported hypersensitivity to exotic fruit in birch pollen allergic patients. Allergology International 52:199–206.

Eriksson, N., A. Holmén, C. Moller, and J.A. Wilh. 1998. Sensitisation according to skin prick testing in atopic patients with asthma or rhinitis at 24 allergy clinics in Northern Europe and Asia. Sensitisation patterns, relationships to residence, diagnosis, age and sex. Allergology International 47:187–196.

Eriksson, N.E., J.A. Wihl, H. Arrendal, and S.O. Strandhede. 1984. Tree pollen allergy. II. Sensitisation to various tree pollen allergens in Sweden. A multi-centre study. Allergy 36:610–617.

Eriksson, N.E., C. Moller, S. Werner, J. Mognussan, U. Bergtsson, and M. Zolubas. 2004. Self-reported food hypersensitivity in Sweden, Denmark, Estonia, Lithuania, and Russia. Journal of Investigational Allergology & Clinical Immunology 14:70–79.

Geller-Bernstein, C., Y. Zaharan, and Y. Waisel. 1994. Sensitivity to olea European pollen in different populations in Israel. European Annals of Allergy and Clinical Immunology 26:318–319.

Ghunaim, N., H. Gronlund, M. Kronqvist, R. Gronneberg, L. Soderstrom, S. Ahlstedt, and M. van Hage-Hamsten. 2005. Antibody profiles and self-reported symptoms to pollen-related food allergens in grass pollen-allergic patients from northern Europe. Allergy 60:185–191.

Johansson, S.G.O., T. Bieber, R. Dahl, P.S. Friedmann, B.Q. Lanier, R.F. Lockey, C. Motala, J.A. Ortega Martell, T.A.E. Platts-Mills, J. Ring, F. Thien, P. Van Cauwenberge, and H.C. Williams. 2004. Revised nomenclature for allergy for global use: Report of the Nomenclature Review Committee of the World Allergy Organization, October 2003. Journal of Allergy and Clinical Immunology 113:832–836.

Kihlstrom, A., G. Lilja, G. Pershagen, and G. Hedlin. 2002. Exposure to birch pollen in infancy and development of atopic disease in childhood. Journal of Allergy and Clinical Immunology 110:78–84.

———. 2003. Exposure to high doses of birch pollen during pregnancy and risk of sensitisation and atopic disease in the child. Allergy 58:871–877.

Kristoffersen, P. 1999. Growing trees in road foundation materials. Journal of Arboriculture 23:57–76.

Magnusson, J., X.P. Lin, A. Dahlman-Hoglund, L.A. Hanson, E. Telemo, O. Magnusson, U. Bengtsson, and S. Ahlstedt.

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2003. Seasonal intestinal inflammation in patients with birch pollen allergy. Journal of Allergy and Clinical Immunology 112:45–50.

Mancuso, G., and R.M. Berdondini. 2001. Oral allergy syndrome from kiwi fruit after a lover's kiss. Contact Dermatitis 45:41.

Mothes, N., F. Horak, and R. Valenta. 2004. Transition from a botanical to a molecular classification in tree pollen allergy: Implications for diagnosis and therapy. International Archives of Allergy and Immunology 135: 357–373.

Mothes, N., and R. Valenta. 2004. Biology of tree pollen allergens. Current Allergy and Asthma Reports 4: 384–390.

Nakagawa, H., N. Ohashi, A. Omura, Y. Watanabe, H. Teranishi, and Y. Keyaki. 1996. Clinical manifestations of Japanese cedar pollinosis: An epidemiological study. Rhinology 34:201–205.

Ogren, T.L. 2000. Allergy-Free Gardening: The Revolutionary Guide to Healthy Landscaping. Ten Speed Press, Berkeley, CA.

Ortolani, C., M. Ispano, E.A. Pastorello, A. Bigs, and R. Ansaloni. 1988. The oral allergy syndrome. Annals of Allergy, Asthma and Immunology 61:47–52.

Osterballe, M., T.K. Hansen, C.G. Mortz, and C. Bindslev-Jensen. 2005. The clinical relevance of sensitisation to pollen-related fruits and vegetables in unselected pollen-sensitised adults. Allergy 60:218–225.

Pumhirun, P., P. Towiwat, and P. Mahakit. 1997. Aeroallergen sensitivity of Thai patients with allergic rhinitis. Asian Pacific Journal of Allergy and Immunology 15: 183–185.

Reekers, R., M. Busche, M. Wittman, A. Kapp, and T. Werfel. 1999. Birch pollen-related foods trigger atopic dermatitis in patients with specific cutaneous T-cell responses to birch pollen antigens. Journal of Allergy and Clinical Immunology 104:466–472.

Saebo, A., T. Benedika, and T.B. Randrup. 2003. Selection of trees for urban forestry in the Nordic countries. Urban Forestry and Urban Greening. 2:101–114.

Stevens, W.J., D. Ebo, M. Hagedorens, C. Bridts, and L. De Clerck. 2003. Is the prevalence of specific IgE to classical inhalant aeroallergens among patients with respiratory allergy changing? Evidence from two surveys 15 years apart. Acta Clinica Belgica 58:178–182.

Taylor, P.E., R.C. Flagan, A.G. Miguel, R. Valenta, and M.M. Glovsky. 2004. Birch pollen rupture and the release of aerosols of respirable allergens. Clinical and Experimental Allergy 34:1591–1596.

Ware, G.H. 1994. Ecological basis for selecting urban trees. Journal of Arboriculture 20:98–103.

Wickens, G.E. 2001. Economic Botany: Principles and Practice. Kluwer Academic, Dordrecht, The Netherlands. 535 pp.

Ian F. Spellerberg (corresponding author)
Isaac Centre for Nature Conservation
Lincoln University
New Zealand
spelleri@lincoln.ac.nz

Nils E. Eriksson
Department of Research and Development
Central Hospital
Halmstad, Sweden

Vincent St. A. Crum
Auckland Allergy Clinic
Auckland, New Zealand

Résumé. Le bouleau pleureur (*Betula pendula*) est communément utilisé comme arbre de rue dans les régions à climat tempéré. Cependant, la littérature médicale foisonne de rapports quant aux effets sur la santé par le pollen du bouleau pleureur. Dans plusieurs pays comme la Nouvelle-Zélande, le bouleau pleureur est l'arbre principal qui cause ces symptômes d'allergies, incluant la fièvre des foins, asthme et autres problèmes de santé comme les allergies alimentaires (syndrome de l'allergie orale). L'exposition au pollen du bouleau pleureur est plus sujette à se produire dans les villes en raison des nombres d'arbres et de la densité de la population humaine. Même s'il existe des doutes quant à l'étendue du problème et des coûts associés, le principe de précaution devrait s'appliquer. Les problèmes de santé associés au bouleau pleureur devraient être promulgués et ces arbres devraient être éliminés.

Zusammenfassung. In den gemäßigten Klimazonen wird die Silberbirke häufig als Strassenbaum gepflanzt. In der medizinischen Fachliteratur gibt es allerdings Berichte über die Auswirkungen der Birkenpollen auf die Gesundheit. In vielen Ländern, wie z. B. Neuseeland, löst hauptsächlich die Silberbirke allergische Reaktionen inklusive saisonales Heufieber, Asthma und andere Gesundheitsstörungen wie Lebensmittelallergien aus. Der Kontakt mit Birkenpollen ist in Städten größer wegen der Anzahl der Bäume und der Bevölkerungsdichte. Auch wenn über das Ausmaß der Problematik und er assoziierten Kosten Zweifel bestehen, sollten dennoch Vorsichtsmaßnahmen getroffen werden. Die Gesundheitsprobleme sollten veröffentlicht und die Bäume entfernt werden.

Resumen. El abedul (*Betula pendula*) es comúnmente utilizado como árbol urbano en regiones de clima templado. Sin embargo, la literatura médica tiene reportes de efectos del polen en la salud de las personas. En muchos países tales como Nueva Zelanda, el abedul es la principal causa de síntomas alérgicos con fiebres, asma y otras afectaciones a la salud, como alergias a los alimentos (síndrome de alergia oral). La exposición al polen de abedul es más probable que ocurra en las ciudades debido al número de árboles y a las densidades de población humana. Aunque hubiese dudas acerca de la extensión del problema y los costos asociados, el principio precautorio debe aplicarse. Los problemas a la salud asociados al abedul deben ser publicados y probablemente los árboles deban ser removidos.

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