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LETTER TO THE EDITOR

Pollen Assisted Migration Faces Its Own Challenges

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We commend Chludil et al. (2025) for exploring novel ways to help forest trees adapt to new climates. We also recognize the many challenges involved in implementing assisted migration in forestry, especially when there is societal resistance or policy barriers to moving genetic materials across geopolitical boundaries. However, pollen-based assisted migration (AM) faces several major hurdles, and the advantages are more limited than presented.

AM in forestry conventionally involves taking seed from an appropriate source climate, growing seedlings in a nursery, and planting the seedlings in the target climate to help cope with climate change (Pedlar et al. 2012; Aitken and Bemmels 2015; Palik et al. 2022). Instead, Chludil et al. (2025) propose pollen AM, whereby pollen is collected from orchard trees from the source climate and applied to orchard trees from the target climate. The resulting mixed-parentage seedlings are then planted in the target climate. Chludil et al. (2025) argue that migrating pollen rather than seed or seedlings will increase the effectiveness and public acceptance of AM. We argue that pollen AM solves few of the general challenges faced by AM, while having unique limitations and disadvantages.

Before considering pollen AM, we address the general challenges associated with AM described by Chludil et al.: (1) adaptation to non-climatic environmental factors; (2) insufficient transfer guidelines and phytosanitary risks; (3) barriers faced by local nurseries; and (4) legal obstacles in plant transport.

First, the authors claim that AM overlooks non-climatic factors associated with planting sites. Soil biotic and abiotic properties typically vary on too fine a spatial scale to be considered in provenance trials or seedlot selection systems. Furthermore, compared to climatic factors, evidence for local adaptation of tree populations to soil properties is weak (e.g., Frank et al. 2017). Photoperiod is, however, considered in conventional AM (O'Neill et al. 2017).

Second, the authors mention the challenge of insufficient transfer guidelines; however, this applies equally to conventional and pollen AM. The development of transfer guidelines for pollen AM is further complicated by the potential for non-additive inheritance if source and target populations are widely diverged, and by seedlots that could include paternal contributions from AM pollen and local wind-born pollen.

According to the authors, conventional AM complicates nursery procedures when new species and seed sources are needed. However, the introduction of new species is outside of the scope of pollen AM. If conventional AM and pollen AM seedlings are each adapted to the target climate, nursery practices for producing them are unlikely to differ substantially.

Concerns regarding pest introductions have rightly constrained seedling AM across some geopolitical boundaries. However, given significant threats of climate change, it is imperative that we develop technical and regulatory solutions that permit seed transfer based on climate, while eliminating phytosanitary risks. For example, risks from conventional AM can be reduced or eliminated by moving seeds instead of seedlings. Seeds are less likely to introduce pests, can be treated, and can be screened for pathogens using genomic techniques (Feau et al. 2023).

Pollen AM has some distinct disadvantages: (1) It requires seed orchards in both source and target climates; (2) handling pollen is operationally complex, expensive, and time consuming; and (3) it requires long-distance pollen sourcing.

First, pollen AM relies on having pairs of orchards for each planting climate—one orchard with locally adapted trees and another from which appropriate pollen can be collected. In contrast, conventional AM can use seed from a single orchard or from forest stands.

Second, pollen AM is operationally complex, expensive, and time-consuming compared with conventional AM. Large-scale pollen collection and storage require infrastructure and skilled labor. Delaying phenology to synchronize reproductive stages, controlled mass pollination, and supplemental mass pollination are costly and time-sensitive.

Third, supplemental mass pollination success rates rarely exceed 30% in older orchards and are often much lower (Lai et al. 2010). To obtain seedlots that, on average, are adapted to a target planting climate, more climatically distant source populations would be required for pollen AM than for conventional AM. This could lead to new procurement and legal challenges. Also, while the simulation model was parameterized assuming a high degree of heterosis, there is little evidence of heterosis in inter-provenance hybrids.

In summary, we argued that pollen AM will be costly, unfeasible in many jurisdictions, and less effective than seedling AM. However, pollen AM may face less scrutiny, public resistance, and regulatory barriers in some settings compared to conventional AM. Thus, it may allow AM to occur where seed-based AM is impossible. Nonetheless, given the pace and extent of climate change, obtaining public acceptance of conventional AM and developing solutions that will permit seed movement across geopolitical boundaries will yield less expensive, more effective, and more predictable results.

Author Contributions

Gregory A. O'Neill: writing – original draft. **Glenn T. Howe:** writing – review and editing. **Sally N. Aitken:** writing – review and editing.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

Data sharing not applicable to this article as no datasets were generated or analyzed during the current study.

Linked Articles

This article is a Letter to the Editor regarding Chuldil et al., https://doi.org/10.1111/gcb.70014. See also the Response to the Letter by Chludil et al, https://doi.org/10.1111/gcb.70262.

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