Exploiting a Key Physiological Feature of Himalayan Balsam (*Impatiens glandulifera*) for Selective, Non-Chemical Control in a Native Woodland Understory

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Abstract

Himalayan balsam (*Impatiens glandulifera*) is a highly invasive annual that outcompetes native understory plants in temperate woodlands, threatening biodiversity. Conventional control methods, such as herbicide application and mechanical cutting, often risk collateral damage to desirable native species. This study evaluates a novel, non-chemical control method that exploits Himalayan balsam's physiological vulnerability as an annual plant with limited carbohydrate reserves. In 2025, black damp-proof membrane was applied over six distinct woodland plots with dense Himalayan balsam infestations for 20 days. A matched set of six plots served as untreated controls. At the conclusion of the treatment, the invasive plants in the shaded plots exhibited a 100% mortality rate, with zero remaining plant cover. In contrast, control plots there was >95% coverage of Himalayan balsam. Co-occurring native perennial species, including *Fraxinus excelsior*, *Hedera helix*, *Circaea lutetiana*, and *Rubus idaeus*, exhibited only transient chlorosis and fully recovered post-treatment, showing no lasting harm. In 2026, a more structured test was carried out using seven black buckets for shanding over 18 days, and seven untreated plots. All plants under the buckets died, whereas those that were unshaded continued their rapid growth. This selective shading method offers an effective, low-impact, and statistically validated alternative for managing Himalayan balsam in sensitive woodland ecosystems.

Introduction

Himalayan balsam (*Impatiens glandulifera* Royle) is a significant invasive species in UK woodlands (Beerling & Perrins 1993). Its rapid growth, prolific seed production, and explosive seed dispersal allow it to dominate native vegetation, suppressing biodiversity and increasing soil erosion along riparian zones (Perrins et al. 1993). Existing control techniques have notable drawbacks. Glyphosate use risks spray drift, harming non-target native flora (Smith et al. 2023). Manual pulling is labour-intensive, while strimming is non-selective and can damage native perennials. Ellison et al. (2020) demonstrated that a coevolved rust fungus may have some efficacy in controlling this species.

Himalayan balsam's annual life history strategy relies heavily on rapid, continuous photosynthesis to fuel its growth, with minimal carbohydrate reserves stored in its succulent stems and shallow roots (Beerling & Perrins 1993; Taiz & Zeiger 2010). In contrast, native perennial understory species possess woody tissues and more extensive root systems that store carbohydrates, enabling them to tolerate short periods of light deprivation and recover quickly (Taiz & Zeiger 2010). This study was designed to exploit these physiological differences to selectively kill Himalayan balsam while minimising impacts on native plants.

Methods

The initial study was conducted in May–June 2025 in a mixed broadleaf woodland at Holy Loch Nature Reserve, Sandbank (grid ref. 56oN, 5oW). Six plots (each 3 m x 4 m) with >95% Himalayan balsam coverage were selected for treatment. An identical set of six adjacent plots, also with >95% coverage of Himalayan balsam, served as untreated controls. Black damp-proof plastic membrane was applied flat over the treatment plots and secured with bricks to ensure complete light exclusion. The membrane remained in place for 20 days, covering the active growth period of Himalayan balsam.

Alternative control methods (glyphosate application, manual pulling, strimming) were evaluated but deemed unsuitable for this site due to environmental risks (drift), labour demands, and potential non-selective damage.

In May 2026, the effect of shading was tested in a more structured experiment. A simple experiment was set up in a uniform stand of young plants. Fourteen plots were arranged in a 2 × 7 layout. Seven plots were randomly assigned to receive a shading treatment using upturned black buckets, and seven plots served as untreated controls (Fig. 4). Eighteen days later, the buckets were removed and the plots were assessed as Himalayan balsam present and healthy, or collapsed, undergoing autolysis and/or dead (Fig. 5).

Results

2025

At the end of the 20-day shading period, Himalayan balsam plants in all six treated plots had 100% mortality. Stems collapsed and died within two weeks of the membrane being removed (figure 1), resulting in 0%coverage. In contrast, the six untreated control plots remained heavily infested with vigorous Himalayan balsam (>95% cover).

An Exact Binomial Test, based on the Binomial distribution, was used to estimate the likelihood of observing complete mortality across all six shaded plots by chance. The result was highly significant ($p < 0.0001$), confirming that the mortality was a direct consequence of the shading treatment.

Native perennial plants within the shaded plots exhibited signs of leaf chlorosis immediately after the membrane was removed (Fig. 2), consistent with temporary chlorophyll degradation. However, all native species recovered full green coloration and vigour within 30 days (Fig. 3),.

2026

There were no living, green, healthy plants left under any of the seven bucket treatments, while the control treatments all had at least three healthy plants (Figs. 4 and 5). A Fisher's Exact Test of plot-level outcomes (healthy plants present vs absent) showed a highly significant effect of bucket shading on plant mortality ($p < 0.001$), with all shaded plots lacking any surviving healthy plants and all control plots retaining at least three healthy individuals, and no deaths.

Costs were approximately £3 per m² of plastic membrane and £3 per bucket. Labour required for installation and removal was around ten minutes per plot,and 10 seconds per bucket.

Discussion

The overall aim of this and all Himalayan balsam control efforts is to prevent seed production and reduce the seed bank, which is critical for long-term management success. This study provides compelling evidence that short-term, complete shading is an effective method for controlling Himalayan balsam. By leveraging its specific physiological weakness as a rapidly growing annual with limited carbohydrate reserves, the treatment selectively eliminates the invasive species while leaving native perennials unharmed. The statistically significant results from this study add to the evidence for the effectiveness of a method that has long been anecdotally applied in agriculture (known as 'occultation' or 'tarping') and provides a quantitative basis for its use in conservation.

While the method is not suitable for all topographies, it represents a valuable, environmentally friendly alternative to chemical or mechanical controls in sensitive woodland settings, and on riverbanks where it might be more difficult to pull by hand.

Anecdotal observations in spring 2026 of the plots treated in 2025 showed germination of just one Himalayan balsam seedling, and healthy green growth of the native flora. Because any viable seeds in these plots must have been shed in 2024 or prior, this near-absence of recruitment suggests that the local seed bank is short-lived. Although no formal seed-longevity studies have been published for Himalayan Balsam, the 2026 observations are consistent with the commonly held view that most seeds do not persist for more than one to two years.

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Figure 1. Dead stems of Himalayan balsam 14 days after removal of shading in 2025.

Figure 2. Rectangular shaded area immediately after removal of plastic in 2025, showing chlorosis in surviving native flora, and a sharp border with the unshaded dark green vegetation made up with 95% Himalayan Balsam.

Figure 3. Previously shaded area 30 days after shade removal in 2025.

Figure 4. Bucket treatment layout in 2026

Figure 5. Results from 2026 showing lack of plants in any plots covered with a black bucket for 18 days.

References

Beerling D. D. & Perrins J.J.S. (1993) *Impatiens glandulifera* Royle (Himalayan balsam). Journal of Ecology, 81, 367–382. https://doi.org/10.2307/2261175

Ellison, C. A., Pollard, K.M. & Varia, S. (2020) Potential of a coevolved rust fungus for the management of Himalayan balsam in the British Isles: first field releases. Weed Research, 60, 37- 49. https://doi.org/10.1111/wre.12403

Perrins J., Fitter A. & Williamson M. (1993) Population biology and control of invasive plants. In: Starfinger U et al. (eds.) Biological Control of Weeds. Wiley & Sons.

Taiz L & Zeiger E (2010) Plant Physiology, 5th Edition. Sinauer Associates, Sunderland, MA.

Smith, A., Kanjithanda R., Hayashi T., French, J. & Milner, R. (2023). Reducing herbicide input and optimizing spray method can minimize nontarget impacts on native grassland plant species. Ecological Applications. 33, https://doi.org/10.1002/eap.2864.