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RESEARCH NOTE

Seedbank longevity of kiwifruit, *Actinidia chinensis* var. *deliciosa*

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Summary Kiwifruit (*Actinidia* spp.) is an important horticultural crop, but unmanaged self-propagation results in 'wild kiwifruit', a serious environmental weed that can harbour pests and diseases, threatening New Zealand's kiwifruit industry. Seed is the main dispersal mechanism for wild kiwifruit, and its longevity impacts weed-management planning. To determine the persistence of wild kiwifruit seed in a seed bank, we buried 800 kiwifruit seeds (*A. chinensis* var. *deliciosa* 'Hayward') in fine-mesh bags at a single depth (5–10 cm) in well-draining sandy loam under simulated field conditions. Bags were retrieved annually for three years and seed germination rates assessed in the last two years. Germination declined markedly between 24 and 36 months: seeds buried for 24 months showed high germination (80%), whereas those buried for 36 months exhibited very low germination (1%). This sharp decline indicates that wild green kiwifruit forms a short-lived seedbank, with most seeds losing viability between two and three years. These findings support the practical feasibility of eradicating wild kiwifruit populations following plant removal, provided seed rain is prevented. Also, these findings reinforce the importance of continued vigilance by industry and land managers, in covering fruit bins, using bird netting, and removing or mulching old vines, to minimise seed escape and reinvasion risk. Our results strengthen confidence that local eradication of wild kiwifruit is achievable with sustained management.

Keywords wild kiwifruit, Hayward, buried seed, weed management

INTRODUCTION

The term "wild kiwifruit" refers to kiwifruit plants (*Actinidia* spp.) that establish and spread outside cultivated orchards through self-propagation. These wild plants have been attributed primarily to green kiwifruit *Actinidia chinensis* var. *deliciosa* because this variety has historically been the most widely cultivated *Actinidia* species in New Zealand. However, other *Actinidia* species, particularly *A. chinensis* var. *chinensis* (Zespri Gold) and *A. arguta* (Kiwiberry), have also been found in the wild (Jon Sullivan *pers. comm*, 2022). Wild kiwifruit is listed in Regional Pest Management Plans (RPMP) in five regions of New Zealand (including the Bay of Plenty, which is New Zealand's largest kiwifruit-growing region) because of its potential environmental and economic impacts. Surveillance and control efforts, reported by Kiwifruit Vine Health (KVH) in 2025, cost approximately $650,000 annually and are funded by the kiwifruit industry, individual landowners and the Bay of Plenty Regional Council. In addition, Tasman District Council, Marlborough District Council, and the Waikato Regional Council contribute substantial in-kind support for surveillance activities to assist in the management of wild kiwifruit (Kiwifruit Vine Health 2025).

Wild kiwifruit is considered a serious environmental weed (McAlpine & Howell 2024). It forms heavy blankets of vines that can smother native bush and threaten biodiversity, and can also invade gullies, shelter belts and forestry plantations (Sullivan et al. 2007). Wild kiwifruit populations also pose a biosecurity risk to New Zealand's commercial kiwifruit industry, as they can act as a reservoir and potential vector for *Pseudomonas syringae* pv. *actinidae* (Psa-V), a disease that kills vines and has cost the New Zealand kiwifruit industry an estimated $900 million since its detection in 2010 (Vanneste 2017).

Wild kiwifruit is dispersed primarily by birds, with seed surviving gut passage, but deer, possums and rats are also potential dispersal vectors (Logan & Xu 2006; Wotton & McAlpine 2015). Each fruit can contain between 400 to 1500 seeds depending on cultivar (Broussard et al. 2021; Nardozza et al. 2010; Seal et al. 2016; Wu 2014); this volume of seed contributes to the invasiveness of wild kiwifruit. Reject fruit left uncovered on commercial vines or in open bins can be a significant source of seed dispersal by birds. Seed is the main mechanism for wild kiwifruit dispersal but dumped vine prunings can re-root and can also play a role in the spread of wild kiwifruit (Sullivan & Williams 2002).

Understanding the longevity of buried kiwifruit seed is critical for monitoring and managing reinfestation following weed removal. If the seed bank depletes within a relatively short period, eradication becomes feasible because wild kiwifruit requires 5–10 years to reach reproductive maturity and is a conspicuously large vine for many years prior to fruiting, making it readily detectable by weed-control contractors (Sullivan & Williams 2002).

This research note presents the results from 800 buried green kiwifruit (*Actinidia chinensis* var. *deliciosa*, 'Hayward' cultivar) seeds, from which we infer the likely longevity of buried wild kiwifruit seed. These findings will help to guide weed-management decisions regarding surveillance timeframes and the level of financial investment required to prevent reinvasion from the seedbank and support long-term eradication efforts following plant removal.

MATERIALS AND METHODS

Seed collection

In June 2021, 10 commercially grown green kiwifruit (Hayward cultivar) were purchased from a Waikato supermarket. Kiwifruit pulp was manually removed from the seed, and kiwifruit seeds were spread out to dry onto paper towels at room temperature over a few days before burial.

Buried seed

Two plastic crates approximately 1 m^2 square and 800 cm high were filled with Horotiu silt loam soil, which is categorised as well-draining and is a common Waikato agricultural soil.

Eight 10 × 10 cm bags made from 40-denier black nylon stocking material were filled with 100 kiwifruit seeds per bag (total seeds n = 800). Four bags were buried 5–10 cm deep into each crate to ensure bags were well covered with topsoil. The crates containing soil and mesh bags were in a secure caged outdoor area at Ruakura Research Centre which was exposed to outdoor weather and rain conditions to simulate field conditions. To minimise possible disturbance of the buried seed by birds, the soil surface was covered with a layer of black shade cloth (See Figure 1).

Assessments

All the buried seed bags were dug up 12 months after burial in June 2022 and visually checked. All seeds appeared plump, full, uniform and in good condition. The seed bags were then re-buried and left for a further 12 months. Four bags were retrieved (two from each crate) and tested for germination

Figure 1 Outdoor crate with buried kiwifruit seed.

in June 2023 (24 months post burial), and the remaining four bags were retrieved and tested for germination in June 2024 (36 months post burial).

Germination testing was initiated by removing the seeds from the mesh bags and spreading them evenly between moist paper towels. The towels were sealed inside zip-lock bags and placed in an incubator set at 25 °C (12 h light: 12 h dark). Germination was checked every 1–3 days. A radicle length of at least 1 mm was used as the criterion for germination. Monitoring continued until no additional seeds germinated for two consecutive weeks after the last recorded germination.

Statistical analyses

A chi-square test of independence was used to analyse germination outcomes. Proportions of germinated versus non-germinated seeds (a binary response) were compared between the 24-month and 36-month burial treatments. Replicate bags and replicate crates were handled by pooling the data across all replicates within each treatment.

RESULTS AND DISCUSSION

Germination of buried kiwifruit seed

Germination of buried kiwifruit seeds declined significantly over the three years. Seeds retrieved after two years exhibited high germination (average 80%), whereas seeds

Table 1 Kiwifruit seed germination after 24 and 36 months of burial.

Time buried (months)	Germinated (out of 400 seeds)	Not germinated (out of 400 seeds)	Mean proportion germinated (%)	95% confidence interval
24	320	80	80±9	76–84
36	5	395	1±2	0.4–2.9

retrieved after three years showed very low germination (1%). A chi-square test indicated a highly significant reduction in germination between 24 and 36 months (χ^2 = 603, df = 1, p<0.0001) (Table 1).

Seeds retrieved after 12 months appeared to be in good condition (firm, full, and comparable to fresh seeds) so germination testing was not conducted at that stage. These same seed cohorts showed more than 80% germination after 24 months of burial, so it is reasonable to assume that viability at 12 months was at least as high. This 80% germination rate is comparable to, and sometimes higher, than germination rates for dormancy-broken kiwifruit seed and freshly bird-dispersed seed (Logan & Xu 2006).

The potential influence of seed dormancy on the longevity wild kiwifruit seed, and its implications for weed management could not be determined in this study but warrants consideration. Kiwifruit has morpho-physiological dormancy, which can be broken by stratification, alternating temperatures and physical degradation, varying by species (Esfandiari et al. 2024; Windauer et al. 2016). Given the germination rates observed after 24 months, it is likely that the soil conditions broke any innate dormancy.

The decline in viability between 24 and 36 months of burial suggests that wild kiwifruit seed survival at a depth of 5–10 cm is limited beyond two years. This loss of viability is likely due to progressive deterioration, microbial activity, and other environmental stresses within the soil (Long et al. 2015). These findings align with the observations of Sullivan and Williams (2002) who estimated that seed continued to germinate after plant removal for "at least three years" based their monitoring of a Bay of Plenty field site where fruit had been dumped. These authors suggested that wild green kiwifruit maintains only a limited seedbank, potentially extending to about five years.

Although limited, the results of the current study indicate some grounds for optimism regarding the practical eradication of wild kiwifruit populations. However, this study did not incorporate several important variables that influence seedbank dynamics and seed viability in the field. Factors such as site-to-site variation, soil type, stratification conditions, rainfall patterns, the nature of seed deposition (e.g., seeds in bird droppings versus discarded fruit), burial depth, and the potential for seed dormancy (Maghdouri et al. 2021) and variation among kiwifruit cultivars were not assessed here. In addition, the possibility of reinvasion from nearby, undiscovered wild kiwifruit plants, via ongoing seed dispersal by birds or other animals, remains an important management consideration. Based on our findings, we consider that monitoring and managing volunteer wild green kiwifruit (Hayward cultivar) seedlings will be required for a minimum of three seasons following seed deposition. The relatively short persistence of buried seed observed in the current study should provide growers and weed managers with greater confidence that eradication of wild kiwifruit populations is both financially viable and operationally achievable, provided that surrounding areas are also effectively surveyed for undiscovered source plants.

Looking ahead, the kiwifruit industry, and other agricultural vine sectors, should consider the potential for cultivated plants to escape via seed dispersal and incorporate seedbank research for other species and new cultivars (e.g. Green14, Gold3, Hort16A and Red18, Red80 and Kiwiberry) into their biosecurity and climate-change preparedness planning. Habitat disturbance is likely to become more common as climate change leads to warmer conditions in some regions of New Zealand and increases the frequency of extreme weather events (e.g., flooding and storm damage). Such disturbance creates favourable conditions for wild kiwifruit establishment, increasing the risk of cultivated vines "jumping the fence" from orchards into surrounding ecosystems.

CONCLUSIONS

This small study supports earlier field observations that wild kiwifruit has a short-lived seedbank. After 36 months of burial in well-drained soil, only 1% of seeds remained viable, indicating rapid viability loss over time. For weed management purposes, we suggest a five-year monitoring programme following the removal of wild kiwifruit plants and the cessation of further seed rain. This timeframe should be sufficient to (cautiously) confirm eradication, given the short seedbank viability of green kiwifruit.

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