Globalization reflected in alien floras: uncovering the Australian origin of South African grain aliens in Belgium

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Samenvatting. – ***Globalisering in de adventiefflora: het ontrafelen van de Australische herkomst van Zuid-Afrikaanse graanadventieven in België.*** *Meer dan drie decennia onderzoek in België naar adventieve planten geassocieerd met de import van graan en oliehoudende zaden — de zogenaamde graanadventieven — toont aan dat de soortensamenstelling in de loop der jaren duidelijke veranderingen heeft ondergaan. In de afgelopen jaren doken meerdere taxa op die geografisch niet in overeenstemming zijn met de vermoedelijke herkomst van het ingevoerde graan. Opvallend is de frequente aanwezigheid van akkeronkruiden uit zuidelijk Afrika zoals* Oncosiphon pilulifer *en* Arctotheca calendula*, ondanks het feit dat geen graan van daar wordt ingevoerd. Onderzoek wijst op een belangrijk aandeel van graanimport uit Australië, met Oekraïne als secundaire bron. Tot voor kort werden er echter geen Australische akkeronkruiden vastgesteld op overslagplaatsen. De vondst in 2024 van* Eragrostis parviflora *— een soort die endemisch is in Australië en nergens anders is ingeburgerd — vormt een directe aanwijzing voor introductie via Australisch graan. Een ander opvallend geval is* Panicum gilvum*, een soort uit zuidelijk Afrika die al geruime tijd voorkomt in Australische akkerbouwgebieden. De soort werd in 2024 voor het eerst herkend in België, op een graanloskade in Gent. Verder onderzoek toonde echter aan dat ze al minstens sinds twee decennia voorkomt in Belgische maïsakkers, maar over het hoofd werd gezien door verwarring met* P. dichotomiflorum*. Deze laattijdige herkenning, gecombineerd met haar status als Australisch akkeronkruid, wijst sterk op een introductie via Australische graanimport. Dit inzicht werpt bovendien mogelijk ook nieuw licht op de reële herkomst van een andere Zuid-Afrikaanse soort*, Panicum schinzii*, die al jarenlang in Belgische maïsakkers voorkomt en eveneens ingeburgerd is in Australië. In dit artikel bespreken we deze bevindingen, en onderstrepen we het belang van veranderingen in internationale handelsroutes bij het analyseren van de biogeografie van exoten.*

Résumé. – ***La mondialisation dans la flore adventice : la mise en évidence de l'origine australienne des adventices grainières sud-africaines en Belgique.*** *Plus de trois décennies de recherches sur les plantes adventices associées aux importations de céréales et de graines oléagineuses en Belgique — les dites "adventices grainières" — ont révélé des évolutions marquées dans la composition floristique. Ces dernières années, plusieurs taxons sont apparus dont l'origine géographique ne correspond pas à celle des produits importées. Des adventices sud-africaines telles que* Oncosiphon pilulifer *et* Arctotheca calendula *sont notamment observées de manière régulière, malgré l'absence apparente d'importations de grains en provenance d'Afrique du Sud. Des investigations ont mis en évidence une augmentation significative des importations de céréales depuis l'Australie, l'Ukraine représentant une source secondaire. Jusqu'à récemment, aucun taxon adventice typiquement australien n'avait toutefois été identifié sur les sites de transbordement. La découverte en 2024 de* Eragrostis parviflora *— une espèce endémique de l'Australie, non naturalisée ailleurs — constitue un indice direct d'introduction via les importations de céréales australiennes. Un autre cas remarquable est celui de* Panicum gilvum*, une espèce sud-africaine naturalisée de longue date dans les cultures australiennes, identifiée pour la première fois en Belgique en 2024 sur un quai de déchargement de céréales à Gand. Des recherches ultérieures ont révélé que l'espèce est en réalité présente dans les champs de maïs belges depuis au moins deux décennies, mais était confondue avec* P. dichotomiflorum*. Cette identification tardive, combinée à son statut d'adventice agricole en Australie, suggère fortement une introduction via les importations australiennes. Ces observations invitent également à reconsidérer l'origine de* Panicum schinzii*, une autre espèce sud-africaine naturalisée dans les champs de maïs en Belgique et également présente en Australie. Cet article analyse en détail ces découvertes et discute de leurs implications pour la compréhension des routes commerciales mondiales et de la biogéographie des plantes exotiques.*

Abstract. – *Over three decades of research on adventive plants associated with grain and oilseed imports in Belgium —so-called "grain aliens"— have revealed shifting patterns in species composition. In recent years, several taxa have emerged that are inconsistent with the presumed geographic origin of the imported grain. Notably, southern African weeds such as* Oncosiphon pilulifer *and* Arctotheca calendula *are now regularly encountered, despite the apparent absence of grain imports from southern Africa. Inquiries indicate that a substantial increase in grain shipments has occurred from Australia, with Ukraine being a secondary source. Until recently, however, no unequivocally Australian arable weeds had been identified at transshipment sites. The 2024 discovery of* Eragrostis parviflora *— a species endemic to Australia and not naturalized elsewhere — provides a direct indication of introduction via Australian grain imports. Another striking case is* Panicum gilvum*, a southern African species long naturalized in Australian croplands and first identified in Belgium in 2024 on a grain unloading quay. Subsequent investigations revealed that* P. gilvum *has in fact been established in Belgian maize fields since at least*

two decades, but went unnoticed due to confusion with P. dichotomiflorum. *The species' belated recognition in Belgium, together with its prominence as an arable weed in Australia, points to Australian grain as the likely vector of introduction. These observations may also shed new light on the true origin of another South African weed,* Panicum schinzii, *which has been established in Belgian maize fields for years and is likewise naturalized in Australia. This paper explores these findings in detail and discusses their implications for understanding global trade pathways and the biogeography of alien plant species.*

Illustrations :
Rutger Barendse (Fig. 1), Filip Verloove (Fig. 2, 3, 4) and Sipke Gonggrijp (Fig. 5).

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Introduction

Before the Industrial Revolution, the introduction of adventive plants typically followed a predictable geographic pattern: Australian species arrived from Australia, South African ones from South Africa, and so on. However, starting in the 19th century, the Industrial Revolution began to alter these patterns, as increased shipping, railway expansion, and the mechanization of agriculture enabled faster and broader movement of goods — and, unintentionally, seeds of weed species (e.g., Chapman *et al.* 2017). These effects were further amplified in the 20th century by the globalization of trade (e.g., Hulme 2021). As agricultural goods were increasingly transported across continents, seeds often accompanied shipments as unintended contaminants. In the absence of effective measures to prevent the introduction and spread of weed seeds, many of these seeds readily established themselves in recipient regions — particularly when climatic conditions were similar to those of their native ranges. Initially colonizing port areas, some species subsequently spread via their own dispersal mechanisms or through human infrastructure such as roads and railways.

As a consequence, the global weed flora has become progressively homogenized, blurring the distinction between primary and secondary distribution ranges. Many grain and oilseed aliens now have extensive global distributions, making it difficult to ascertain their true geographic origin. In many cases, adventive species may be introduced from either their native range or a secondary area where they have previously become naturalized, depending on the source of imported grain. *Grindelia squarrosa* (Pursh) Dunal, for example, has occasionally been recorded near grain mills in Belgium. Although native to North America, it is also a noxious weed in Ukraine (Protopopova *et al.* 2021), and both countries are major exporters of grain and oilseeds to Belgium.

The situation becomes even more complex when alien species are found that are native to regions from which no grain is imported. In recent years, several conspicuous southern African weeds — such as *Oncosiphon pilulifer* and *Arctotheca calendula* — have repeatedly been observed as grain aliens in Belgian port areas. While grain imports from southern Africa are not documented, all of these species are known to be naturalized in Australia. Indeed, Australia has long grappled with invasive agricultural weeds, many of them South African in origin (Scott & Delfosse 1992), and the threat of additional problematic species originating in South Africa remains (Scott & Panetta 1993).

We recently became aware that Australia has become one of Belgium's principal suppliers of grain and oilseeds in the past decades. Despite this, there was still a puzzling absence of native Australian weeds at Belgian grain handling sites — a stark contrast with the mid-20th century, when large imports of Australian wool brought with them a distinct alien flora composed largely of endemic Australian species (Verloove *et al.* 2026). A breakthrough came in 2024 with the discovery of *Eragrostis parviflora* (R.Br.) Trin. in the port area of Ghent. This species is native to Australia and has not been recorded as naturalized elsewhere. The occurrence of this species in Belgium provides a clear indication of direct introductions via Australian grain, which is also a vector for the introduction into our region of southern African weeds that have become naturalized in Australia.

In this paper, we discuss the repeated occurrence of some southern African weed species in Belgian grain-handling areas, which have most likely arrived via their secondary range in Australia. We also examine the recent discovery of the Australian endemic grass *Eragrostis parviflora* and its implications for our understanding of globalization-driven plant dispersal. Finally, we consider how this perspective may also shed new light on the long-established presence of *Panicum schinzii* in Belgian maize fields.

Results

Arctotheca calendula (L.) K.Lewin (Fig. 1)

Arctotheca calendula is native to South Africa, occurring naturally in the Cape Provinces, Free State, KwaZulu-Natal, and Lesotho. Over time, the species has been introduced and became naturalized in several regions — including the Mediterranean, Australia, and California (POWO 2024). In these non-native areas, its invasive potential has gained recognition, as documented by several studies (e.g., Wood 1994; Brundu *et al.* 2015; Sakhraoui *et al.* 2024).

In Belgium, historical records indicate that *A. calendula* was sporadically present as an ephemeral wool alien in the Vesdre River valley between 1902 and 1947 (Verloove 2006). Because wool was primarily imported from both Australia and South Africa, the plants could have originated from either the primary or a secondary distribution area.

Since 2012, however, *A. calendula* has been regularly observed yet again in Belgium. The species has been detected near grain storage facilities in the port areas of Ghent (Sifferdok and Rodenhuizedok) and Antwerp (Kanaaldok). Given that Belgium does not import grain directly from South Africa, the source of these introductions was initially unclear. Subsequent inquiries revealed that a significant volume of grain — including oilseeds

such as canola or rapeseed — is imported from Australia. In Australia, *A. calendula* has established itself as an invasive, herbicide-resistant weed in agricultural fields (Khalil *et al.* 2021), particularly in canola-growing regions (Lemerle *et al.* 2001). Accordingly, it appears most likely that the populations recently recorded in Belgium have been introduced from this secondary range in Australia.

Herbarium:

Harbour of Ghent, Rodenhuizedok (IFBL C3.43.42), unloading quay for cereals, few plants, all non-flowering, 09.09.2012, *F. Verloove* 9716 (BR0000024510677);

Harbour of Ghent, Sifferdok near Bronsstraat (IFBL C3.53.33), unloading quay for cereals, scattered individuals, flowering and fruiting, 09.09.2012, *F. Verloove* 9734 (BR0000024510660);

Harbour of Antwerp, E side of Kanaaldok (IFBL B4.55.41), rough ground near Cargill grain mill, two individuals, 25.05.2014, *F. Verloove* 10723 (BR0000024510653);

Harbour of Ghent, Rodenhuizedok (IFBL C3.44.31), unloading quay for cereals (GGT), 1x, 28.09.2014, *F. Verloove* 11115 (BR0000024510646).

Figure 1. *Arctotheca calendula* on the grain unloading quay at the Sifferdok in the Ghent port area in September 2012.

Eragrostis parviflora (R.Br.) Trin. (Fig. 2)

Eragrostis parviflora is native to Australia and adjacent regions, including New Caledonia and New Guinea. Although it has occasionally been reported as an adventive species outside its native range — particularly in the past — it does not appear to be naturalized anywhere beyond Australasia. Alleged records of its naturalization in Hawaii are now considered incorrect and based on misidentifications, most probably due to confusion with *E. pectinacea* (Facenda 2022).

Historically, *E. parviflora* has been closely associated with the wool trade, and it appears to be a common weed in sheep-grazing areas of Australia. In Belgium, it was once one of the most characteristic 'wool aliens' with numerous collections documented between 1887 and 1969 (Verloove 2006). Within its native range, the species is still commonly encountered as a weed, particularly in irrigated agricultural systems (AusGrass2 2024) and along roadsides (Lazarides 1997).

In autumn 2024, several individuals of *E. parviflora* were discovered beneath and around grain conveyors at both the Sifferdok and Rodenhuizedok in the Ghent port area. Although Australian grain imports into Belgium date back several decades, the discovery of *E. parviflora* constitutes one of the most unambiguous cases of a weed species introduced directly from its primary range via this pathway. Given that *E. parviflora* has not naturalized outside its native region, its recent appearance in Belgium provides compelling evidence of direct introduction from Australia.

E. parviflora is a visually distinctive and graceful grass, characterized by its long, pendulous inflorescence, which can reach lengths of up to 60 cm — hence its common name, 'Weeping Lovegrass'.

Herbarium:

Ghent, port area, Sifferdok at Bronsstraat (IFBL C3.53.33), roadside and unloading quay near grain storage, at least 6 individuals, 06.10.2024, *F. Verloove* 15171 (BR0000027059548V).

Figure 2. *Eragrostis parviflora* on the grain unloading quay at the Sifferdok in the Ghent port area in September 2024. The large, weeping inflorescences with verticillate lower branches are particularly distinctive.

Oncosiphon pilulifer (L.f.) Källersjö (Fig. 3)

Oncosiphon pilulifer is native to South Africa, where it occurs in the Cape Provinces, Free State, KwaZulu-Natal, Lesotho, and the Northern Provinces (POWO 2024). It typically inhabits sandy soils along roadsides and other disturbed environments (Kolokoto & Magee 2018). Outside of its native range, the species has naturalized only locally. In the southwestern United States (particularly Arizona and California), it has been present since the 1980s and it is anticipated to become one of the region's most troublesome invasive species, spreading from disturbed areas into adjacent natural habitats (Hedrick & McDonald 2020). It is also naturalized in Western Australia, where it has emerged as a significant weed in grain-producing regions (Thompson 2007; Michael *et al.* 2010). Under projected climate change scenarios, *O. pilulifer* is even predicted to become the fastest-increasing weed in Western Australia (Michael *et al.* 2011).

In Belgium, *O. pilulifer* was first recorded in 2017 on fallow ground at the Cargill grain transshipment site in the Kanaaldok area of the Port of Antwerp. Since then, it has been observed regularly at the site, often with dozens of individuals present. From 2019 onwards, the species was also recorded along the Sifferdok in the

Port of Ghent, consistently near grain storage facilities.

Morphologically, *O. pilulifer* closely resembles another recently detected grain alien, *Tripleurospermum decipiens* (Fisch. & C.A.Mey.) Bornm., a species native to Iran and Turkey. Both taxa are characterized by finely dissected foliage and typically discoid yellow flower heads. However, *O. pilulifer* can be readily distinguished by its cypselae, which lack resin sacs, and by its disc florets, which are markedly wrinkled and possess only four lobes (as opposed to five in *T. decipiens*).

The origin of *O. pilulifer* in the Belgian ports was initially uncertain, as Belgium does not import grain from South Africa. However, employees at the Cargill mill in Antwerp indicated that, during the post-harvest season, most grain and oilseed imports originate from Australia and Ukraine. Given the species' naturalization and weed status in Australia, it is plausible that *O. pilulifer* reached Belgium as a contaminant of Australian grain shipments — having already traveled far beyond its native range before its arrival in Europe.

Herbarium:

Harbour of Antwerp, E side of Kanaaldok (IFBL B4.55.41), unloading quay for cereals at Cargill mill, two individuals, 02.07.2017, *F. Verloove* 13016 (BR0000027059562V);

Harbour of Ghent, Sifferdok at Bronsstraat (IFBL C3.53.33), ground heaps near grain storage, several dozen, 05.05.2019, *F. Verloove* 13488 (BR0000025861723V);

Harbour of Ghent, Sifferdok at Bronsstraat (IFBL C3.53.33), ground heap at grain mill, several dozen, 19.05.2019, *F. Verloove* 13500 (BR0000025861754V);

Antwerp, port area, E side of Kanaaldok (IFBL B4.55.41), rough ground at Cargill grain mill, 03.07.2022, *F. Verloove* 14357 (BR);

Ghent, port area, Moervaart, roadside at unloading quay for cereals Cargill, 20.08.2023, *F. Verloove* 14858 (BR0000026352497V).

Figure 3. *Oncosiphon pilulifer* near the Cargill grain mill at the Kanaaldok in the Antwerp port area in July 2022.

Panicum gilvum Launert (Fig. 4, 5)

In autumn 2024, several individuals of *Panicum gilvum* were discovered at the cereal unloading quay along the Sifferdok in the Port of Ghent. The species is native to Botswana, Namibia, and the Cape and Northern Provinces of South Africa (POWO 2024), and this marks its first formal record in Belgium. Since Belgium does not import grain from southern Africa, the most plausible explanation is that the plants were introduced via Australian grain shipments. This is further supported by the simultaneous discovery of the Australian weed *Eragrostis parviflora* at the same site.

Although *P. gilvum* is a relatively obscure taxon, it turns out to have been present in Belgium for at least two decades, though consistently misidentified as the morphologically similar American species *P. dichotomiflorum*. Data presented in Hoste *et al.* (2026, this issue) indicate that *P. gilvum* has been naturalized in maize fields in the northern border region between East and West Flanders since at least 2007. Recent molecular analyses confirm that specimens collected in Belgium and in Dutch Limburg belong to *P. gilvum*. A thorough re-examination of historical herbarium specimens of *P. dichotomiflorum* and *P. schinzii* collected as wool aliens in the Vesdre valley, may yet uncover misidentified material of *P. gilvum*. Nevertheless, such findings would bear no relation to the recently naturalized populations in maize fields, which clearly originate from a distinct and more recent introduction route.

Panicum gilvum, *P. dichotomiflorum*, and *P. schinzii* all belong to *Panicum* sect. *Dichotomiflora*. Despite their close morphological resemblance, several subtle but consistent differences exist. *P. gilvum* is usually prostrate-ascending, with relatively small (2–10 cm long, sometimes longer), sparsely flowered panicles that typically remain enclosed within the upper leaf sheaths. Plants usually show a reddish tinge to the lower sheaths. Spikelets tend to be slightly shorter (c. 2.5–2.7 mm in Belgian material), with acute rather than acuminate apices. Notably, the palea of the lower floret is almost as long and wide as the fertile lemma — contrasting with *P. dichotomiflorum*, in which the palea is usually somewhat narrower. *P. chloroticum*, a rare casual alien, often has a vestigial palea. *P. schinzii*, by contrast, is erect in habit, has a fully exserted panicle at maturity, male lower florets, and generally blunter spikelets. While Launert (1970) originally described the lower floret of *P. gilvum* as "male (always?)", examination of two syntypes preserved at the Naturalis herbarium in Leiden (Dinter #2544 and Seydel #2210) clearly shows the lower floret to be sterile. This observation aligns with more recent treatments (Fish *et al.* 2015; Zuloaga 2022). AusGrass2 (2024) also notes that Australian populations deviate from Launert's description in this respect.

Morphologically, *P. gilvum* closely resembles *P. dichotomiflorum*, leading F. Reijerse to consider the syntypes of *P. gilvum* to be conspecific with the latter (annotations on herbarium specimens, Naturalis, Leiden). However, recent molecular analyses (Verloove *et al.*, in prep.) place *P. gilvum* in a distinct clade more closely related to the southern African *P. schinzii* than to *P. dichotomiflorum*, which is native to the Americas. This phylogenetic relationship is also more biogeographically plausible.

Outside of its native range, *P. gilvum* has been recorded only sporadically. It was once reported in the British Isles as a wool alien (Clement 1981), but never established. In contrast, it is currently recognized as an agricultural weed in several Australian states, including New South Wales, Northern Territory, Queensland, Tasmania, and Victoria (AusGrass2 2024; various online sources). According to data from the Atlas of Living Australia, *P. gilvum* is at least twice as commonly recorded in Australia as *P. schinzii*.

These findings may also shed new light on the naturalization history of *P. schinzii* in Belgium. Initially recorded as an ephemeral wool alien in the Vesdre valley (last observed in 1953; Verloove 2001), *P. schinzii* has become a regular and naturalized maize field weed in Belgium since 1983. Its exact introduction pathway, however, has remained unclear. Most maize weeds are believed to have been introduced via animal manure containing undigest-

ed seeds from cattle feed (e.g. Sotiaux *et al*. 1981; Mt. Pleasant & Schlather 1994; Larney & Blackshaw 2003). Since cattle feed over the past half-century has largely been sourced from North America, it is unsurprising that many maize field weeds in Belgium are of North American origin, or widely naturalized there in crop fields [e.g., *Echinochloa muricata* (P.Beauv.) Fernald, *P. dichotomiflorum*, *Setaria faberi* R.A.W.Herrm.]. The confirmed presence of *P. gilvum* in Australia and its misidentification in Belgium since at least two decades now suggest that *P. gilvum* and *P. schinzii* may both have arrived via the same route: not directly from southern Africa, but from their secondary, weedy range in Australia. Unfortunately, the timeline of large-scale grain imports from Australia into Belgium is not well documented. However, the recurrent presence of another Australian endemic weed, *Echinochloa inundata* Michael & Vickery, near grain and cattle feed factories in Belgium since 1995 (Verloove & Vandenberghe 1996) strongly suggests that such imports already became significant during the 1990s. For earlier decades, notably the 1980s when *P. schinzii* first became established, this introduction route remains more speculative. Nevertheless, considering the absence of grain imports from southern Africa, introduction via Australia remains the most plausible explanation for the presence of both *P. gilvum* and *P. schinzii* in Belgium. Both species have long been established in Australia — records indicate their presence there since at least the 1930s–1940s — providing ample time for accidental introduction via Australian cereal imports.

Herbarium:

Ghent, port area, Sifferdok near Bronsstraat (IFBL C3.53.33), unloading quay for cereals, scattered individuals, prostrate plants with poorly-flowered inflorescences hardly exserted, 20.10.2024, *F. Verloove* 15172 (BR0000027059807V) and 15175 (BR0000027059791V).

Figure 4. *Panicum gilvum* on the grain unloading quay at the Sifferdok in the Ghent port area in October 2024. The prostrate stems with reddish lower leaf sheaths are very characteristic.

Figure 5. *Panicum gilvum* on the grain unloading quay at the Sifferdok in the Ghent port area in October 2024. The inflorescence is relatively small and long remains included in the upper leaf sheath. Spikelets are small and acute at apex.

Discussion and conclusion

In the past, the presumed origin of grain aliens in Belgium was often taken at face value: Mediterranean species were assumed to come from the Mediterranean, North American species from North America, and so on. Since grains and oilseeds have indeed been imported from these regions, little attention was given to possible alternative routes. However, owing to advances in understanding, such assumptions warrant reconsideration.

In recent years, canola or rapeseed imported into Belgium appears to originate largely from Australia. Remarkably, in 2022–2023, Belgium was the world's largest buyer of Australian rapeseed, importing nearly one million tons (Grain Central). This trade relationship invites a closer look at the typical weed flora of Australian canola fields (GRDC Grownotes 2015). The 16 most common weed species in such fields are — almost without exception — native to the Mediterranean region. They include classic grain aliens like *Hirschfeldia incana* (L.) Lagr.-Foss., *Rapistrum rugosum* (L.) All., and *Sisymbrium orientale* L., as well as less frequently observed but ecologically significant species such as *Brassica tournefortii* Gouan, *Echium plantagineum* L., and *Emex australis* Steinh. (now often treated as *Rumex hypogaeus* T.M.Schust. & Reveal). Notably, the South African species *Arctotheca calendula*, discussed earlier, is also among the most troublesome weeds in Australian canola crops.

These findings shed entirely new light on the potential origin of grain aliens in Belgian port areas. Species previously assumed to have arrived from the Mediterranean may, in fact, have reached Belgium via a much longer detour through Australia.

The most significant hotspot for these South African–Australian grain aliens is quay 880 of Euroports Belgium in the Ghent port area. It is worthwhile to examine which species have been recorded there in recent years: Mediterranean weeds like *Centaurea melitensis* L., *Echium plantagineum*, *Lolium rigidum* Gaudin, *Rumex pulcher* L., and *Sisymbrium erysimoides* Desf. — all of which are considered major agricultural weeds in Australia (Weeds of Australia) — may well have been introduced from there, rather than directly from the Mediterranean.

Now that the large-scale import of Australian grains and oilseeds into Belgium is a well-established fact — astonishing as it may seem, given the substantial grain production in Europe and tra-

ditional suppliers like North America — the interpretation of the Belgian grain alien flora requires a fresh perspective. Although such (massive) imports are a relatively recent phenomenon, they cannot account for the presence of Mediterranean exotics that have been established in Belgium for much longer. Nevertheless, in the years ahead, we can expect more Australian species to appear, whether endemic to that continent or naturalized from elsewhere.

As demonstrated here, it is necessary to critically reconsider the presumed geographic origins of many grain aliens, especially those with Mediterranean ancestry. Dozens of Mediterranean agricultural weeds are now widely naturalized in Australia and could easily have arrived in Belgium via Australian grain imports. This illustrates the complexity of globalization as a historical process, showing that human-mediated plant dispersal is not only a matter of recent trade but also reflects long-term, multi-directional exchanges. For species native to the Mediterranean, and for which both Mediterranean and Australian supply routes are plausible, pinpointing their precise origin remains difficult. In contrast, the southern African species discussed in this paper — due to their known secondary distributions in Australia and the absence of grain imports from southern Africa — can with much greater certainty be attributed to the Australian route.

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