ALOE ×*INOPINATA* GIDEON F.SM., N.R.CROUCH & OOSTH., (ASPHODELACEAE) [*ALOE ARBORESCENS* MILL. × *ALOE CHORTOLIRIOIDES* A.BERGER VAR. *CHORTOLIRIOIDES*]: A NOTHOSPECIES FROM THE BARBERTON CENTRE OF ENDEMISM, EASTERN SOUTH AFRICA

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Abstract: The natural hybrid between *Aloe arborescens* Mill. and *A. chortolirioides* A.Berger var. *chortolirioides* (Asphodelaceae) is here formally described as a nothospecies, *A.* ×*inopinata* Gideon F.Sm., N.R.Crouch & Oosth. The hybrid occurs at Kamhlabane, about 37 km [22 miles] east of Barberton, as well as at Twello 373JU in the Barberton district, Mpumalanga. It has been known in horticulture for many years, following the introduction of wild-sourced material by Gilbert W. Reynolds.

Keywords: *Aloe arborescens* Mill.; *Aloe chortolirioides* A.Berger var. *chortolirioides*; *Aloe* ×*inopinata* Gideon F.Sm., N.R.Crouch & Oosth.; Asphodelaceae; Barberton Centre of Endemism; history; natural hybrid; nothospecies; South Africa; taxonomy

INTRODUCTION

The ease with which species of *Aloe* L. (Asphodelaceae) hybridise to yield off-spring with varying levels of fertility is well-known (Smith & Figueiredo, 2015a). When first introduced into the climatically more severe Europe, the exclusively Old World aloes were usually grown together under glass where accidental pollination and fertilisation led ultimately to the description of several of the hybrid progenies as 'good' species (see for example Figueiredo & Smith, 2012 on *A.* ×*commutata* Tod.; Smith & Figueiredo, 2015b on *A.* ×*nobilis* Haw.; and Figueiredo & Smith, 2016 on *A.* ×*schimperi* Tod., *A.* ×*schoenlandii* Baker, and *A.* ×*paxii* A.Terracc., respectively). Only with the more detailed exploration of the African, Arabian, Madagascan, and Mascarene land masses was it established that many 'species' were in fact the product of alooid promiscuity in cultivation, or in their natural habitats.

Figure 1. *Aloe arborescens* in the vegetative phase at Barberton Nature Reserve (Mountainlands), where it grows in the mist belt, among other habitats. Photograph: Neil R. Crouch.

Figure 2. The racemes of *Aloe arborescens* are conical and range from sparsely- to densely-flowered. Photograph: Gideon F. Smith.

Figure 3. The shrubby *Aloe chortolirioides* var. *chortolirioides* produces short, variously orientated, *Xerophyta*-like stems that are often scorched and blackened by veld fires. Leaves are nearly linear, except at the much broadened base, and carry small, white teeth on the margins. Photograph: Neil R. Crouch.

Aloe arborescens Mill. (Figures 1–2) is one of the most common parents of both natural and artificial hybrids encountered in *Aloe*, and sometimes with representatives of close generic relatives, with Smith et al. (2012) documenting 31 known hybrid combinations, including nine named ones. Although being largely, but not exclusively, self-incompatible, *A. arborescens* nonetheless hybridises freely across many of the infrageneric groups recognised in *Aloe* by Berger (1905), resulting in what today are in some instances considered to be intergeneric hybrids, based on a recently revised generic classification for *Aloe* (Grace et al., 2013). That *A. arborescens* is so regularly identified as a parent in hybrid events is not surprising as it has the third-widest distribution range of all aloes [after *A. myriacantha* (Haw.) Schult. & Schult.f., and *A. buettneri* A.Berger *sensu lato*]. The range of *A. arborescens* stretches in a near continuous coastal arch from the Cape Peninsula through the Eastern Highlands of Zimbabwe, and into southern Malawi (Smith et al., 2008; 2012). It has been suggested that the occurrence of *A. arborescens* on the Cape Peninsula is a result of the species having escaped from cultivation and its subsequent colonization of natural fynbos vegetation (Moll & Scott, 1981; Kesting, 2003). Forms of *A. arborescens* flower at virtually any time of the year, from mid-winter to mid-summer, and where they occur sympatrically with other co-flowering *Aloe* species, hybrids are frequently generated. Arguably the best known of the natural hybrid swarms to which *A. arborescens* has contributed genes is around Mossel Bay in the southern Cape, the likely area from which *A.* ×*principis* (Haw.) Stearn [=*Pachidendron principis* Haw. (Haworth, 1821: 37–38)] was recorded as a 'species'.

In South Africa, highly floriferous forms of *A. arborescens*—with attractive, sickle-shaped leaves that are carried in dense rosettes—are often used as a parent in deliberate crosses aimed at producing cultivars (Smith & Figueiredo, 2015a). In Europe, *A.* ×*spinosissima* Jahand. is a widely grown hybrid,

Figure 4. The racemes of *Aloe chortolirioides* var. *chortolirioides* are capitate (head-shaped) and range from densely- to sparsely-flowered. Photograph: Delia Oosthuizen.

Figure 5. *Aloe ×inopinata* in its natural habitat at Barberton Nature Reserve (Mountainlands) in the Barberton district, Mpumalanga, South Africa. Photograph: Delia Oosthuizen.

Table 1. Characters on which *Aloe ×inopinata* can be separated from *A. arborescens* and *A. chortolirioides* var. *chortolirioides*.

Character	*Aloe arborescens*	*Aloe ×inopinata*	*Aloe chortolirioides* var. *chortolirioides*
Plant height (cm)	*c.* 100–300	50–60	20–30
Leaf width (mm)	*c.* 50	8–25	*c.* 3
Leaf maculation	without spots; lineation absent	without spots; very rarely spotted; longitudinally lined with lighter stripes	often with spots on leaf bases; often longitudinally lined with a light green central stripe
Colour of leaves that dry on the stems	dull light brown	purplish-brown	purplish
Inflorescence shape	conical	conical to abruptly conical	capitate
Raceme length (cm)	20–30	10–15	*c.* 5

with *A. arborescens* and the miniature *A. humilis* [var. *echinata* (Willd.) Baker] being the parents (Smith, 2005: p. 85; Smith & Figueiredo, 2015a: p. xiii, Figures 1 and 2).

We here describe the natural hybrid between *Aloe arborescens* and *A. chortolirioides* A.Berger var. *chortolirioides* (Figures 3–4) as *Aloe ×inopinata* Gideon F.Sm., N.R.Crouch & Oosth. (Figure 5). Over the past 50 years plants have become established in horticulture, and the hybrid was recently recorded from two additional localities. Note that the surname 'Oosthuizen' of one of us (DO), has not been published before as the author of a plant name; initials are accordingly not required. As the name has 10 letters it is abbreviated following the rule that it should end at a consonant preceding a vowel (Brummitt & Powel, 1992). Diagnostic characters, and information on the habitat and geographical distribution range of this nothospecies are provided.

BACKGROUND

While conducting research towards his magna opera (Reynolds, 1950, 1966), Dr Gilbert W. Reynolds became the most widely travelled of all the students of the genus *Aloe*. During his extensive field trips in search of aloes he covered more than 240,000 km [150,000 miles] on the African continent, Madagascar, and beyond (Reynolds, 1950; 1966; Walker, 2010; Crouch et al., 2013). This enabled him to determine the provenance of several species that up to that time had been known in cultivation only, as well as to reflect on the parentage of other 'species' that had not been recorded from the wild. On the basis of his own field observations he was therefore able to resolve the origin of what speculatively were hybrids. Accordingly, in his works on the aloes of Africa and Madagascar he included lists of all natural hybrids that he encountered.

In Reynolds (1950: 413) 15 natural hybrids are listed as having *Aloe arborescens* as one parent. One of these (Reynolds 1950: 413, natural hybrid 3) is with *A. chortolirioides* [var. *chortolirioides*] as the other parent, which Reynolds referred to as an "…unexpectedly wide cross…", and earlier in the book, on p. 127, as "A very wide and unexpected cross". On p. 413 he further noted that the "…plant transplanted readily, and grew well". This hybrid is illustrated under the treatment of *A. chortolirioides* (Reynolds 1950: 126, Figure 95), where it was recorded as the only natural hybrid known to Reynolds involving *A. chortolirioides*. It should be noted that, while two varieties are currently recognised in *A. chortolirioides*—the typical one and *A. chortolirioides* var. *woolliana* (Pole-Evans) Glen & D.S.Hardy—it was at species rank that Reynolds (1950: 128–129) recognised *A. woolliana* Pole-Evans.

Reynolds was a regular visitor to the National Herbarium of South Africa, a facility of what was then the Division of Botany and Plant Pathology, later the Botanical Research Institute (BRI), in Pretoria (Gunn & Codd, 1981). This amenity is currently part of the South African National Biodiversity Institute (SANBI). Although Reynolds rarely published in the Division's house journal, *Bothalia*, he sometimes disseminated his research findings in the Division's other outlet, *The Flowering Plants of South Africa*. However, he preferred for the most part to describe the alooid and other plant novelties he encountered in the then fledgling *Journal of South African Botany* of the Kirstenbosch National Botanic Garden (Klopper et al., 2013). It was likely during a visit made by Reynolds to the National Herbarium that he provided material of the hybrid to Mr Dave (David Spencer) Hardy [born Pretoria, 24 September 1931; died Pretoria, 31 May 1998], at the time a horticulturist employed in the Pretoria National Botanical Garden, which is also today part of SANBI's network of National Botanical Gardens (Glen, 1998). Hardy grew material of the hybrid in a glasshouse in the nursery area of the Garden. One of us (GFS) had occasion to visit Hardy in the early 1980s and was shown material of the plant, where it thrived in comparatively low light conditions adjacent to an artificial pond, in virtually year-round wet soil. Hardy freely distributed material of this hybrid (and other plants he kept in the nursery, for that matter; see Glen, 1998: 240) to visitors, and plants became widely available, especially among amateur collectors of aloes, and succulent growers in general.

At the type locality of *Aloe ×inopinata* several plants grow within an area of about 100m^2, together with both parents. Additionally, *A. craibii* Gideon F.Sm. and *A. barbertoniae* Pole-Evans occur within this small spot of exceptional aloe richness. This cluster occurs within that area near Barberton bounded by the topocadastral square 2531CA, which is rec-

Figure 6. The shrubby *Aloe* ×*inopinata* is in all respects finer and more graceful-looking than *A. arborescens*, with the leaves much narrower. Photograph: Delia Oosthuizen.

ognised currently as the most aloe-diverse hotspot in southern Africa (see Crouch et al., 2013, Figure 2). The *Flora of Southern Africa* (FSA) region is one of three major centres of present-day species denseness in aloes, East Tropical Africa and Madagascar comprising the other two (Carter et al., 2011). Holland (1978) earlier demonstrated that *Aloe* diversification could largely be explained by terrain diversity, which was given as a function of local relief, degree of dissection of terrain, steepness or otherwise of slopes and the complexity of the array of slope facets. In the Barberton region there is great terrain diversity, as well as heterogeneity of altitude, soil, and local climate conditions.

DIAGNOSTIC CHARACTERS OF *ALOE* ×*INOPINATA*

Although in most respects intermediate between the two parent species, *Aloe* ×*inopinata* can be easily separated from *A. arborescens* and *A. chortolirioides* var. *chortolirioides* based on gross vegetative and reproductive morphological characters. While a short-stemmed, shrubby entity, much like *A. arborescens*, *A.* ×*inopinata* is in all respects finer and more graceful-looking than *A. arborescens*, with the leaves much narrower (Table 1; Figure 6). The leaves of *A.* ×*inopinata* are often adorned with faint or prominent longitudinal lines, especially on the adaxial surface, like those of *A. chortolirioides* var. *chortolirioides*, but generally lack spots (Figure 7). The immaculate nature of the leaf surfaces is a character shared with *A. arborescens*. In rare instances both surfaces of the leaves of *A.* ×*inopinata* are sparsely white-spotted (Figure 8), a character in turn inherited from the other parent, *A. chortolirioides* var. *chortolirioides*, where spots are particularly noticeable at the broad leaf base. Interestingly, leaves that dry on the stems of *A.* ×*inopinata* persist for a time (unlike those of *A. chortolirioides* var. *chortolirioides* that often burn off in the veld fires to which the species is so well adapted). The leaves themselves, as well as the exposed surface of freshly

Figure 7. The leaves of *Aloe* ×*inopinata* are often adorned with lighter green longitudinal lines, especially on the adaxial surface, and are mostly immaculate. Photograph: Delia Oosthuizen.

Figure 8. In rare instances both surfaces of the leaves of *Aloe* ×*inopinata* are sparsely white-spotted. Note the exotic *Pinus* plantations in the background. Photograph: Delia Oosthuizen.

Figure 9. The dry leaves of *Aloe* ×*inopinata* that remain attached to the stems take on a purplish-brown colour. Photograph: Delia Oosthuizen.

Figure 10. The racemes of *Aloe ×inopinata* are shorter than those of *A. arborescens* (Figure 2), and longer and more conical than those of *A. chortolirioides* var. *chortolirioides* (Figure 4). Photograph: Delia Oosthuizen.

broken leaves of the hybrid, dry a purplish-brown colour (Table 1; Figure 9). Not many species of *Aloe* have leaves that dry purple on the stems, *Aloe succotrina* Weston from the Western Cape being a notable exception (Walker et al., 2015).

In terms of inflorescence morphology, the racemes of *Aloe ×inopinata* are shorter than those of *A. arborescens* (Figure 10), and longer and more conical than those of *A. chortolirioides* var. *chortolirioides*. Likewise, floral density on the racemes of *Aloe ×inopinata* is intermediate between the parents.

GEOGRAPHICAL DISTRIBUTION RANGES OF *ALOE ARBORESCENS*, *A. CHORTOLIRIOIDES*, AND *A. ×INOPINATA*

Aloe arborescens is a widespread species occurring in southern Africa from the Cape Peninsula eastwards in a fairly narrow near-coastal band through KwaZulu-Natal, and inland to the eastern Free State, Mpumalanga, Swaziland, and South Africa's Limpopo Province. It has also been recorded from mostly mountainous areas in central and eastern Zimbabwe, southern and central Mozambique, and southern Malawi (Figure 11; red on map).

Aloe chortolirioides has a much more limited geographical distribution range that is focussed around Barberton in Mpumalanga, and northern Swaziland, with outlying localities recorded from South Africa's Limpopo Province (Figure 11; orange on map).

The distribution ranges of *Aloe arborescens* and the nominate variety of *A. chortolirioides* overlap in Mpumalanga, Swaziland, and Limpopo. However, the hybrid has a narrow geographical distribution range and is only known from three relatively close localities, all in South Africa's Mpumalanga Province (Figure 11; black on map). It has been recorded from only the Barberton district, from near the summit of Kamhlabane, about 37 km [22 miles] east of Barberton in the Eastern Transvaal [now Mpumalanga] by Reynolds (1950: 126), and Twello 373JU, where two sites are known some 3 km [2 miles] apart. The two Twello localities, within the Barberton Nature Reserve (Mountainlands) and Songimvelo Nature Reserve respectively, are each approximately 11 km [7 miles] east of Barberton. All three localities fall within the Barberton Centre of Endemism (Van Wyk & Smith, 2001).

DESCRIPTION OF *ALOE ×INOPINATA*

> ***Aloe ×inopinata*** Gideon F.Sm., N.R.Crouch & Oosth. Sp. nov. **Type**: South Africa, Mpumalanga Province, Barberton district, Barberton Nature Reserve (Mountainlands), Twello 373JU, 1500m [4920'] above sea level, (–CC), 01 March 2016, *D. Oosthuizen 1960* (BNRH holo-).

Diagnosis: Although having a shrubby growth form, *Aloe ×inopinata* differs from the much more robust *Aloe arborescens* in being a smaller plant in all respects, with narrower leaves, the margins of which are adorned with fine, white, firm teeth. The inflorescences of *Aloe ×inopinata* are shorter than those of *Aloe arborescens*, but longer and more conical than those of *Aloe chortolirioides* var. *chortolirioides*. *Aloe ×inopinata* further differs from *Aloe chortolirioides* var. *chortolirioides* in lacking the short, stubby, *Xerophyta*-like stems, and in having much broader leaves that are arranged in larger rosettes.

Description: Much-branched shrub, 0.5–0.6 m high. **Stems** up to 3.5–4.0 cm in diameter, erect, branching at or near the base, branches spreading, with persistent dried leaves for 5–7 cm. **Rosettes** 0.4–0.6 m in diameter. **Leaves** densely rosulate, at branch apices, spreading, becoming recurved, light to mid-green, without spots or rarely with scattered white spots on both surfaces, texture smooth, lanceolate-attenuate, 20–40 cm long, 0.8–2.5 cm wide at base; margin whitish or of similar colour to that of leaf surface, with small, firm, white teeth, straight or basally pointed towards stem and apically forward-pointing, 0.8–1.2 mm long, 5–9 mm apart at mid-leaf; fresh exudate pale creamy beige, drying purplish. **Inflorescences** 1–2 simultaneously from a rosette, ± 40–60 cm high, erect, simple. **Peduncle** ± 30–50 cm long, ± 10 mm wide at base, green to purplish green, stout, with few, broadly deltoid to ovate-elongated, straw-coloured, scarious, many-nerved sterile bracts, ±12 mm long, 6 mm wide. **Racemes** subconical to conical or conical-cylindrical, 8–10 cm long,

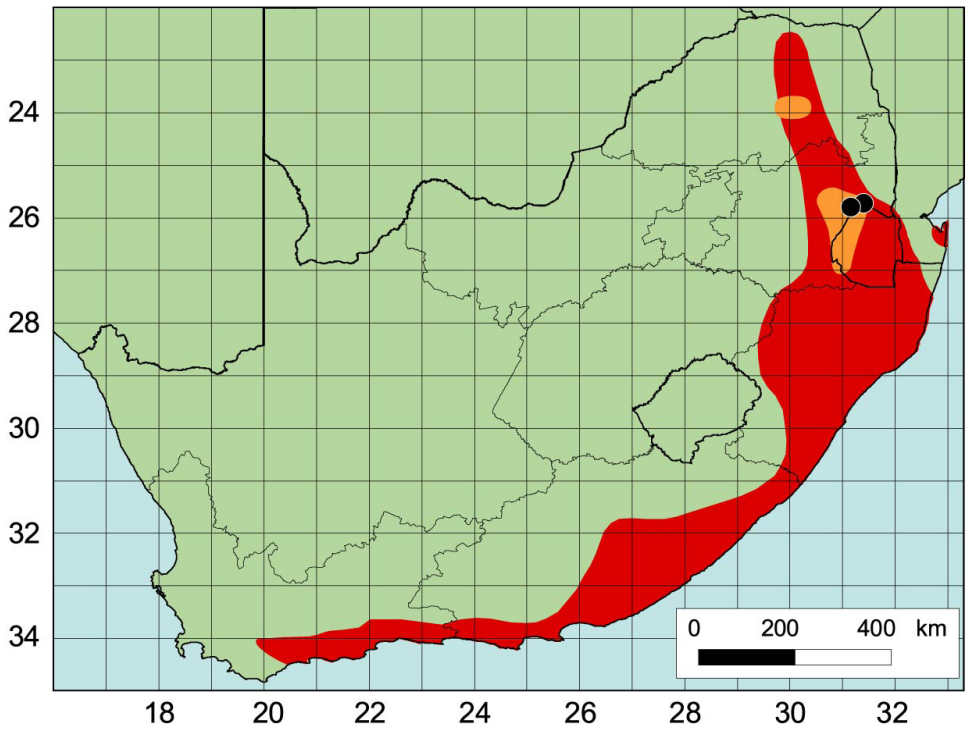

Figure 11. Known geographical distribution ranges of *Aloe arborescens* in South Africa, Swaziland, and southern Mozambique (red on map), and *A. chortolirioides* var. *chortolirioides* (orange on map). The black dots indicate the known localities of *A.* ×*inopinata*.

5–7 cm wide, erect, densely flowered, buds erect to spreading; flowers covered by floral bracts in early development, pendulous when open. **Floral bracts** broadly ovate-elongated, 12–15 mm long, up to 6 mm wide at base, straw-coloured to brownish-white, scarious, many-nerved. **Pedicels** 20–22 mm long, orangey-red. **Flowers**: **perianth** orangey-red, paler towards mouth, purplish-green-tipped in bud, ± 30 mm long, 3–5 mm across ovary, slightly narrowed above ovary, widening slightly towards wide-open mouth, cylindric-trigonous, outer segments free to the base, tips flared; **stamens** with filiform-flattened, yellow filaments, anthers orange-brown, included or slightly exserted; **ovary** 5 mm long, 2.5 mm diameter, green; **style** yellow, exserted for 5–8 mm. **Fruit** obovoid capsule, purplish brown. **Seeds** not seen. **Chromosome number** unknown.

Eponymy: From the Latin *inopinata* (English: 'unexpected') in accordance with Reynolds (1950: 127) who referred to an encounter with this hybrid as "unexpected".

Habitat: Species that grow in association with *Aloe* ×*inopinata* at the Barberton Nature Reserve (Mountainlands) type locality include *Hypoxis limicola* B.L.Burtt [Hypoxidaceae], *Ekebergia pterophylla* (C.DC.) Hofmeyr [Meliaceae], *Streptocarpus dunnii* Hook.f. [Gesneriaceae], *Watsonia watsonioides* (Baker) Oberm. [Iridaceae], *Erica woodii* Bolus [Ericaceae], *Justicia linifolia* (Lindau) V.A.W.Graham (=*Siphonoglossa linifolia* (Lindau) C.B.Clarke) [Acanthaceae], and *Alepidea peduncularis* A.Rich. [Apiaceae]. The hybrid grows in the mist belt at an altitude of *ca*. 1500m [4920'] above sea level on shallow soils amongst rocks and shrubs such as *Burchellia bubalina* (L.f.) Sims [Rubiaceae]. The vegetation type is Barberton Montane Grassland (Gm 17) (Mucina et al., 2006), a mosaic of short grassland and rocky shrubland set in typically rugged terrain.

Flowering time: February to March. In contrast, *Aloe arborescens* is known to flower at any time of the year, with most forms of the species peaking in mid-winter (June to August). The flowering peak of *A. chortolirioides* var. *chortolirioides* is July to August (Bornman & Hardy, 1971: 297). Further, Van Wyk & Smith (2014: 302) has recorded *A. chortolirioides*, without differentiating which variety, as having a long flowering period, which can stretch from March (autumn) to September (spring), and also note that the species will spontaneously flower in response to occasional fires. Evidently both parent species of *A.* ×*inopinata* have a greater or lesser tendency towards out-of-peak-season flowering, and cross-pollination and fertilization during such a chance flowering event may well have given rise to the hybrid. Such stochastic and erratic behaviour also explains why *A.* ×*inopinata* has not been observed across the full range where *A. arborescens* and *A. chortolirioides* are sympatric. It is noteworthy that most slender aloes (*Aloe* sect. *Leptoaloe* A.Berger), the group to which *A. chortolirioides* belongs, as well as the related grass aloes (*Aloe* sect. *Graminialoe* Reynolds) flower in the summer months, like *A.* ×*inopinata*. As the

parents of the nothospecies are anticipated to very rarely flower at the same time as the hybrid, this significantly decreases the likelihood of regression through backcrossing (with the parents), such that speciation through hybridisation may eventuate.

Common names: None recorded.

ADDITIONAL SPECIMENS OF *ALOE ×INOPINATA* EXAMINED

SOUTH AFRICA.

MPUMALANGA PROVINCE [TRANSVAAL *pro parte*].

The National Herbarium in Pretoria (PRE) holds two black & white prints of a plant collected at Kamhlabane with the number *G.W. Reynolds 2827*. The plants figured flowered in his garden on 13 March 1939, and on 07 March 1940. However, no specimens with this number could be traced, and it might be that Reynolds did not make a specimen of this plant, as there are no records of such specimens referenced in the ***Bo***tanical ***Dat***abase of ***S***outhern ***A***frica (BODATSA) (see http://newposa.sanbi.org/).

CULTIVATION AND PROPAGATION OF *ALOE ×INOPINATA*

This hybrid is one of the easiest aloes to cultivate and propagate. It is surprisingly tolerant of high soil moisture levels, growing well even when waterlogged for short periods. Propagation is through the numerous basal and stem sprouts that can be easily removed and rooted in gritty sand.

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