

# Platycarpheae

*Vicki A. Funk, Marinda Koekemoer, Harold Robinson and John J. Skvarla*

## HISTORICAL OVERVIEW

Thunberg (1800) described the type species of *Platycarpha* as a thistle, *Cynara glomerata*, and mentioned its spiny pinnately divided leaves. Lessing (1831) did not think it belonged in the thistles and described the genus *Platycarpha* based on the Thunberg species. De Candolle (1836) placed *Platycarpha* in Vernonieae. Bentham moved *Platycarpha* from Vernonieae into a subtribe of its own in reestablished Arctotideae (1873a, b) and Hoffmann agreed (1890–1894). There it remained until Stix (1960) suggested that *Platycarpha* should be in Mutisieae based on pollen morphology. Robinson and Brettell (1973) put *Platycarpha* in Cardueae (thistles) based on the pollen’s “... prominent complex columnar structure in the thickened rather smooth exine” and the lack of stomates on the corolla lobes; both characters are similar to what they found in Cardueae.

In the book *The Biology and Chemistry of the Compositae* (Heywood et al. 1977), Dittrich (1977), in his treatment of the thistles (Cardueae), rejected *Platycarpha* and returned it to Arctotideae without explanation. In the same volume, Norlin (1977) reviewed Arctotideae and he excluded *Platycarpha* citing the evidence of Robinson and Brettell (1973).

The most recent classifications of Arctotideae (Bremer 1994; Karis 2007) accepted *Platycarpha* in the tribe but listed it as “unassigned to subtribe”. Based on molecular and morphological data the clade has recently been proposed as a tribe: Platycarpheae. Furthermore, two of the species are placed in a new genus, *Platycarphella*, based on morphology (Funk and Robinson 2009).

## PHYLOGENY

What are now Platycarpheae have always been recognized as distinct morphologically, however, they never really fit in the tribe Arctotideae. The analysis of the DNA sequence data showed that the three species form a monophyletic group on a long branch (Funk et al. 2004; Funk and Chan, unpub.) within the subfamily Cichorioideae. The placement of Platycarpheae within the subfamily differed slightly in the analyses of the nuclear and chloroplast DNA (see Chapter 12). The combined analysis produced results that placed Platycarpheae as the sister group to the Liabeae–Vernonieae clade, however, while the individual clades within the subfamily were present in all the parsimony trees, they collapsed into a polytomy in the bootstrap analysis. New markers are being added in an attempt to better resolve the relationships among the clades.

## TAXONOMY

**Tribe Platycarpheae** V.A. Funk & H. Rob. in *Compositae* Newslett. 47: 25. 2009

***Platycarpha*** Less. in *Linnaea* 6: 688. 1831 – Type: *Platycarpha glomerata* (Thunb.) Less.

Perennial herbs (Fig. 29.1), prostrate, acaulescent, stoloniferous, forming clonal mats or individual rosulate plants in close proximity, no milky sap. Leaves prostrate, radiating from central portion of plant, in 2–6 rings with oldest leaves and larger in the lowermost ring; blades oblanceolate, lanceolate, elliptic, or linear, varying in



**Fig. 29.1.** Species of Platycarphaceae. **A** *Platycarpha glomerata* Less., note the spiny leaves, large primary and secondary heads (3–10 cm in diam., this one is 8 cm), and the long styles; **B** *Platycarphella carlinoides* (Oliv. & Hiern.) V.A. Funk & H. Rob., note the leaves flat on the ground and the large secondary head (2–10 cm in diam., this one 10 cm) with many small primary heads; **C** *Platycarphella parviflora* (S. Moore) V.A. Funk & H. Rob., note the small size of the plant, small secondary heads (1–2 cm diam., this one 2 cm), and the entire leaves. [Photographs: A, B, M. Koekemoer; C, V.A. Funk.]

length (1–35 × 0.5–11.0 cm), margins entire, dentate, or pinnatisect, adaxially green and mostly glabrous, with or without spines; abaxially with dense, white tomentum. Inflorescence sessile, one- to many-headed, grouped in a secondary head on a crown, secondary receptacle 2–10 cm in diameter. Heads subglobose to cylindrical, discoid, 3–25 mm in diameter. Involucral bracts (phyllaries) 7–40 in 3–5 series, lanceolate to linear, usually glabrous (some collections of *Platycarphella carlinoides* with tufts of tomentum at apices), outer bracts 6–20 × 1–5 mm, inner bracts becoming smaller and more slender with innermost bracts resembling pales; margins entire, apices acuminate. Disc florets 3–60, bisexual; corollas purple, mauve, lilac, or pink, occasionally white, varying in size from 8 to 23 mm long, lobes 3.0–3.5 mm long with glands on abaxial surface of apex of each lobe; tubes sparsely hispid at distal end; anthers purple, 4–13 mm long, tailed; styles lavender, varying in length, 9–29 mm long, in longer form (*Platycarpha*) the branches terete, with hairs nearly to tip, in shorter branches (*Platycarphella*) slightly tapered with hairs scarcely developed distally. Achenes 3- or 5-sided, dark. Pappus of 7–12 persistent white scales 2–6 mm long, apex acuminate.

There are two genera, *Platycarpha* (one species) from the Eastern Cape and KwaZulu-Natal of South Africa and *Platycarphella* (two species) from central South Africa to the highlands of Namibia. They can be distinguished by an impressive list of characters: pollen type, corolla and style length, primary and secondary head size and leaf type (Funk and Koekemoer, unpub.; Funk and Robinson 2009).

## MORPHOLOGY

Perhaps the most interesting aspect of this tribe is its growth pattern. The secondary heads are the crown of the plant with the roots emanating from the base of the crown; the leaves are produced at the narrow circular perimeter. The heads are strongly attached and even embedded in the surface of the secondary receptacle. The crown is woody. The heads of any one secondary receptacle are of different ages, so while some are in flower, new small heads are forming at the base of old heads. In addition, once a secondary head is past flowering, a new crown can form with another secondary head. At other times, a stolon will form from below an old secondary head and grow some distance before developing a new secondary head. Thus, once an individual becomes established, it can spread over a large area by means of these rhizomes. The leaves usually lie flat on the ground and spread out around the central portion of the plant like the spokes of a wagon wheel, however, when crowded they arch in *Platycarpha*. In *Platycarphella*

sometimes the secondary heads are close together and they push one another upward. The receptacles have narrow pales (receptacular bracts); the discoid heads have 3 to possibly 100 florets, the corollas are purple to pink and they are deeply divided; the anthers are tailed, and the styles have a small swelling just below the base of the style branches that is covered with small hairs; the achenes are only faintly ribbed, and the pappus is composed of 7–12 scales, 2–6 mm long.

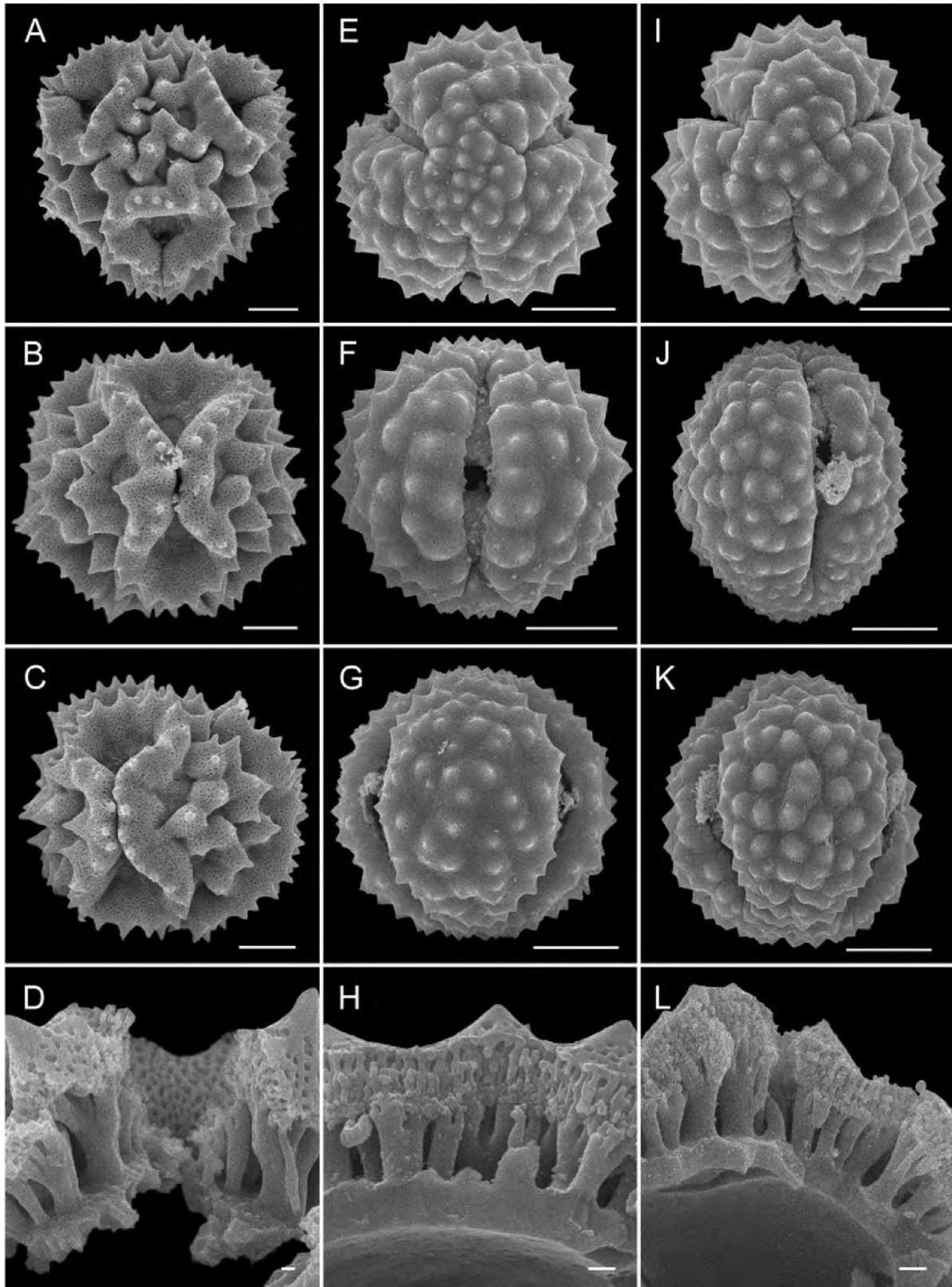
Platycarpeae have recently been revised; for additional information see Funk and Koekemoer (unpub.) and/or Funk and Robinson (2009).

## POLLEN

The pollen morphology of *Platycarphella parviflora* (Fig. 29.2E–H) and *P. carlinoides* (Fig. 29.2I–L) is identical. As described in greater detail elsewhere (Wortley, Funk and Skvarla, 2008), the pollen is echinate with spines approximately 1 μm in height and 2.5–3 μm across their bases and with more than 100 spines distributed over a smooth and minutely perforate surface. The apertures are tricolporate and occasionally syncolpate at the poles. In structure, the pollen is ecaeate (Figs. 29.2H, L) with an infratectum comprised of two distinct columellae layers separated by multilayered internal tecta. The outer layer consists of fine columellae and is approximately 1.2 μm in thickness; the inner columellae layer is over 2 μm in thickness and consists of thickened columellae that are prominently branched at the distal ends.

The pollen of *Platycarpha glomerata* (Fig. 29.2A–D) is in marked contrast to that of *Platycarphella parviflora* and *P. carlinoides*. The minutely perforate exine surface consists of distinct but irregularly arranged ridges separated by lacunar areas that somewhat resemble the lophate pattern common to pollen in Vernoniaceae but the grains are preantheroid, with fused mura continuous around the colpus, bowtie-shaped, at waist fused across the pore dividing it into two pores. Spines and spine bases are somewhat greater than in *P. parviflora* and *P. carlinoides*. The apertures are tricolporate with surrounding ridges commonly obscuring the pore region. There is some structural similarity to *P. parviflora* and *P. carlinoides* in that the lower (inner) columellae are similarly thickened and distally branched (Fig. 29.2D); however, these branches appear to both support as well as form a finer (i.e., weaker) and less complex tectum. This is especially noteworthy in the lacunar areas.

According to Wortley et al. (2007), the *Platycarphella* pollen provides no evidence to link the species to any other group in the subfamily Cichorioideae; that statement was written prior to the discovery of the even more unusual pollen of *Platycarpha*.



**Fig. 29.2.** Scanning electron micrographs of Platycarpeae pollen. **A–D** *Platycarpha glomerata* Less.; **E–H** *Platycarphella parviflora* (S. Moore) V.A. Funk & H. Rob.; **I–L** *Platycarphella carlinoides* (Oliv. & Hiern.) V.A. Funk & H. Rob. **A, E, I** polar view; **B, F, J** apertural view; **C, G, K** lateral view; **D, H, L** fractured grains. Scale bars: whole grains = 10  $\mu\text{m}$ ; fractured grains = 1  $\mu\text{m}$ .

## CHROMOSOME NUMBERS

There are no known chromosome counts for members of Platycarpeae.

## CHEMISTRY

The chemical compounds of two species have been sampled. Bohlmann and Zdero (1977) reported that *Platycarpha glomerata* had five thiophenes and a diol that were isolated from roots, and two germacranolides were isolated from aerial parts, and in Zdero and Bohlmann (1989) they reported that “The chemical investigation of *P. glomerata* gave in addition to thiophenacetylenes, typical of *Berkheya*, some germacranolides.” Their examination of aerial parts of *Platycarphella carlinoides* (Oliv. & Hiern.) V.A. Funk & H. Rob. gave the ent-kaurene derivatives 1, 2, 3a and 4–10, the nor-kaurenes 13–15, the thiophene derivatives 16, ent-16 $\beta$ -hydroxy-kaurane-19-oic acid and the germacranolide 17. The high concentration and the degree of variation in the diterpenes in *P. carlinoides* may indicate a relationship to *Atractylis* (tribe Cardueae, subtribe Carlineae) where nor-kaurene derivatives and their glycosides are present, though in these compounds a 4-methyl group is missing. Diterpenes link *Platycarpha* to *Corymbium* (not in Cichorioideae) and exclude a placement in Vernoniae, where so far no diterpenes or thiophenes such as 16 have been isolated. The latter have so far only been reported from *Berkheya* (Arctotideae) species, which also contain germacranolides. Due to these findings, Zdero and Bohlmann (1989) concluded that the results supported the proposed position of Platycarpeae [*Platycarpha*] intermediate between Arctotideae and Cardueae. In summary, the chemistry is no more helpful than the molecular or pollen data at placing this unique clade.

## BIOGEOGRAPHY

The members of Platycarpeae are native to central and southern Namibia and South Africa. The monotypic *Platycarpha* is found in the Eastern Cape and KwaZulu-Natal provinces of South Africa. *Platycarphella* has two species in the South African provinces of The Free State, Mpumalanga, Northern Cape, and Northwest Province

and in Namibia (Funk and Koekemoer, submitted). The fact that this tribe is endemic to southern Africa strengthens the concept of an African origin for the Cichorioideae (see Chapter 23).

## BIOLOGY AND ECOLOGY

The tribe Platycarpeae is found from the low elevations in the coastal areas of South Africa up to 1800 meters in the high central plateau of Namibia. Its members often grow in open disturbed areas with rocky and sandy soil, in full sun. All of the taxa are apparently unpalatable for grazing animals.

Nothing definite is known about the pollination of this genus, and the only records are photographs of several populations with ants crawling on them. Moreover, there are large nectaries on the abaxial surface at the apex of the lobes of the corollas which may be an attractant for pollinators (Funk and Koekemoer, unpub.).

All three species are allopatric and flower at different times during the year. The diversification within the tribe may be a response to the most recent uplift of the Great Escarpment, which isolated what is now *P. glomerata* around 5 Ma (Linder, pers. comm.).

## ETHNOBOTANY

*Platycarpha glomerata* has several common names in KwaZulu-Natal: ‘imbozisa’ (Gordon-Gray 2003), ‘inyathelo’ and ‘imbozisayabesuthu’, and it is believed to have some magical powers; a concoction of the whole plant (called ‘intelezi’) is sprinkled in the yard around a homestead to protect against lightning strikes (pers. comm. Mkipheni Ngwenya, Zulu Botanical Knowledge Project). Raymond (2002) and Hutchings (1996) report the Zulu name as ‘imboziza’, and Pooley (1998) cites it as ‘usiphahluka’. Plant infusions are known to be used as sprinkling charms against evil spirits (Arnold et al. 2002). *Platycarpha* is apparently not eaten by livestock and feeding tests were negative (Watt and Breyer-Brandwijk 1962), which agrees with our field observations (for all three species): it can be found in pastures and roadsides where all palatable plants have been consumed.

## Literature cited

- Arnold, T.H., Prentice, C.A., Hawker, L.C., Snyman, E.E., Tomalin, M., Crouch, N.R. & Pottas-Bircher, C.** 2002. Medicinal and magical plants of southern Africa: an annotated checklist. *Strelitzia* 13: 36.
- Bentham, G.** 1873a. Notes on the classification, history and geographical distribution of Compositae. *Journal of the Linnean Society, Botany* 13: 335–577.
- Bentham, G.** 1873b. Compositae. Pp. 163–533 in: Bentham, G. & Hooker, J.D. (eds.), *Genera Plantarum*, vol. 2(1). Reeve, London.
- Bohlmann, F. & Zdero, C.** 1977. Neue Germacrolide aus *Platycarpha glomerata*. *Phytochemistry* 16: 1832–1835.
- Bremer, K.** 1994. *Asteraceae: Cladistics & Classification*. Timber Press, Portland.
- Candolle, A.P. de.** 1836. *Prodromus Systematis Naturalis Regni Vegetabilis*, vol. 6. Treuttel & Würtz, Paris.
- Dittrich, M.** 1977. Cynareae—systematic review. Pp. 999–1015 in: Heywood, V.H., Harborne, J.B. & Turner, B.L. (eds.), *The Biology and Chemistry of the Compositae*, vol. 2. Academic Press, London.
- Funk, V.A., Chan, R. & Keeley, S.C.** 2004. Insights into the evolution of the tribe Arctoteae (Compositae: subfamily Cichorioideae s.s.) using *trnL-F*, *ndhF*, and ITS. *Taxon* 53: 637–655.
- Funk, V.A. & Robinson, H.** 2009. A new tribe Platycarphaeae and a new genus *Platycarphella* in the Cichorioideae (Compositae or Asteraceae). *Compositae Newsletter* 47: 24–47.
- Gordon-Gray, K.D. (ed.)**. 2003. *Medicinal Plants Traded on South Africa's Eastern Seaboard*. Ethekwini Parks Department and University of Natal, Durban, South Africa.
- Heywood, V.H., Harborne, J.B. & Turner, B.L. (eds.)**. 1977. *The Biology and Chemistry of the Compositae*, 2 vols. Academic Press, London.
- Hoffmann, O.** 1890–1894. Compositae. Pp. 87–387 in: Engler, A. & Prantl, K. (eds.), *Die natürlichen Pflanzenfamilien*, vol. 4(5). Engelmann, Leipzig.
- Hutchings, A.** 1996. *Zulu Medicinal Plants: An Inventory*. University of Natal Press, Pietermaritzburg.
- Karis, P.O.** 2007 [2006]. Arctotideae. Pp. 200–206 in: Kadereit, J.W. & Jeffrey, C. (eds.), *The Families and Genera of Vascular Plants*, vol. 8, *Flowering Plants. Eudicots. Asterales*. Springer, Berlin.
- Lessing, C.F.** 1831. De synanthereis. *Dissertatio quarta. Linnaea* 6: 624–721.
- Norlindh, T.** 1977. Arctoteae—systematic review. Pp. 943–959 in: Heywood, V.H., Harborne, J.B. & Turner, B.L. (eds.), *The Biology and Chemistry of the Compositae*, vol. 2. Academic Press, London.
- Pooley, E.** 1998. *A Field Guide to Wild Flowers of KwaZulu-Natal and the Eastern Region*. Natal Flora Publications Trust, Durban, South Africa.
- Raymond, R.F.** 2002. *Common Names of some KwaZulu Natal Plants*. Published privately by the author.
- Robinson, H. & Brettell, R.D.** 1973. Tribal revisions in the Asteraceae. VIII. A new tribe, Ursinieae. Arctotideae. Anthemideae. *Phytologia* 26: 76–86.
- Stix, E.** 1960. Pollenmorphologische Untersuchungen an Compositen. *Grana Palynologica* 2: 41–104.
- Thunberg, C.P.** 1800. *Prodromus Plantarum Capensium*. Edman, Upsala.
- Watt, J.M. & Breyer-Brandwijk, M.G.** 1962. *The Medicinal and Poisonous Plants of Southern and Eastern Africa*, 2nd ed. Livingstone, Edinburgh and London.
- Wortley, A.H., Funk, V.A., Robinson, H., Skvarla, J.J. & Blackmore, S.** 2007. A search for pollen morphological synapomorphies to classify rogue genera in Compositae (Asteraceae). *Review of Palaeobotany and Palynology* 146: 169–181.
- Wortley, A.H., Funk, V.A. & Skvarla, J.J.** 2008. Pollen and the evolution of Arctotideae (Compositae). *Botanical Review* 74: 438–466.
- Zdero, C. & Bohlmann, F.** 1989. Platycarphol and other kaurene derivatives from *Platycarpha carlinoides*. *Phytochemistry* 28: 2745–2751.