

Stephen Mifsud & Owen Mifsud

A revision of *Allium* subsect. *Allium* (*Amaryllidaceae*) for the Maltese Islands

Abstract

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A revision of species in *Allium* subsect. *Allium* occurring on the Maltese Islands was done on field and herbarium data. *A. ampeloprasum* L., the presumed endemic *A. melitense* (Borg.) Ciferri & Giacomini and *A. commutatum* Guss. are the three species mentioned in the Maltese floras within this group. The results clearly encompassed four different taxonomic units, corresponding to *A. polyanthum* Schult. & Schult. f. which has never been recorded for the Maltese Islands, two populations of *A. commutatum* and two forms (one sterile, one fertile) of their putative hybrid *A. commutatum* × *A. polyanthum* growing on few coastal areas. *A. ampeloprasum* is excluded from the Maltese islands while *A. melitense* is synonymised with *A. polyanthum*. All past records of *A. commutatum* (apart from a giant form) are referred to *A. polyanthum*. Moreover, *A. commutatum* × *A. polyanthum* is reported from Sicily for the first time.

Key words: *Allium polyanthum*, *A. commutatum*, Malta, Central Mediterranean region.

Introduction

The classification of the genus *Allium* (*Amaryllidaceae*) has been intricate since the pioneer work of Don (1827) and subsequent treatments (Regel 1875; Vvedensky 1935; Feinbrun 1943; Omelczuk 1962), but recent classifications (Friesen & al. 2006; Nguyen & al. 2008; Li & al. 2010) divided the genus into three unnamed clades which are referred to as *lineages*, and which together form 15 different subgenera. These clades were raised to generic level (*Allium*, *Caloscordum* and *Nectaroscordum*) by Banfi & al. (2011) although this treatment is still questionable. Subgenus *Allium* is further divided into fifteen sections, of which section *Allium* is represented by some 115 species. This is further subdivided into two subsections (Hermann 1939): subsect. *Oenoprason* F. Herm. which is characterised with leaves having a semicircular or oblong cross-section and subsect. *Scordoprason* F. Herm. with flat, channelled or V-shaped leaves (Mathew 1996). According to the article 22.1 of the ICN (McNeill & al. 2012) subsect. *Scordoprason* is superfluous and should be corrected to subsect. *Allium*.

The following native species of *Allium* sect. *Allium* have been recorded for the Maltese Islands (Weber & Kendzior 2006; Mifsud 2002-2014; Casha 2013): *A. amethystinum* Tausch. (*Allium* subsect. *Oenoprason*), *A. ampeloprasum* L., *A. melitense* (Sommier & Caruana Gatto) Ciferri & Giacomini (a putatively Maltese endemic) and *A. commutatum* Guss. The latter three species within subsect. *Allium* are dealt in this study.

The first *Allium* species recorded on the Maltese Islands was *A. ampeloprasum*, with the Maltese name “*Korrat selvagg*” (wild leek), flowering in June and growing in fields together with the cultivated *Allium porrum* “*Korrat*” (Zerapha 1827). Grech Delicata (1853) also listed *A. ampeloprasum* as the single species of wild leek in Malta, where he reports it from cultivated and uncultivated places as at Corradino.

Sommier & Caruana Gatto (1915) catalogue *A. ampeloprasum* in their flora which they reported it to grow in various locations on rocky ground, especially near the sea. Additionally, they described a new variety from Boschetto – *A. ampeloprasum* var. *melitense*, which they distinguished because of its smaller hemispherical inflorescences up to 3 cm across and for being plants with a more delicate habit reaching only up to 25 cm in height. They state that this local variety is similar to *A. ampeloprasum* var. *hemisphericum* Sommier (= *A. hemisphericum* (Sommier) Brullo) from Lampedusa and to *A. preslianum* Schult. & Schult. f. (= *A. rotundum* L.), adding that it should be studied in a more taxonomic depth while retaining *A. ampeloprasum* var. *melitense* as a provisional name.

Borg (1927) classifies *A. ampeloprasum* into three varieties: *A. ampeloprasum* var. *ampeloprasum* (Maltese: *Kurrat selvagg*) which flowers in April-May and is very common in rocky places near the sea and near fields; *A. ampeloprasum* var. *porrum* (Maltese: *Kurrat*) which is widely cultivated and *A. ampeloprasum* var. *melitense* considered endemic to Malta. This variety was then elevated to a species level in the catalogue of Italian Flora by Ciferri & Giacomini (1950).

Subsequent floristic accounts and publications maintained Borg’s treatment (Lanfranco G. 1960, 1969; Haslam & al. 1977), until Lanfranco (1989) put forward for the first time the species *A. commutatum* in the Red Data Book. He also questioned the systematic status of *A. melitense*. Additionally, reference was also made to giant forms of ‘*A. commutatum*’ occurring on the islets of Filfla and General’s Rock (found by Michael Briffa). It was concluded that *A. ampeloprasum* complex required further critical investigations (Lanfranco 1989; Lanfranco & Bonnett 2015). Our preliminary field observations also confirmed that the species within *Allium* sect. *Allium* are not represented correctly in the Maltese florae and local floristic accounts and hence a taxonomic revision was carried out.

Materials and methods

The study on *Allium* subsect. *Allium* was carried out between 2014 and 2016 both in Malta and Gozo, mostly from wild samples but cultivated escapees were also included. In addition, material from Cava d’Aliga and Marina di Modica, Ragusa, Sicily; and a three specimens from Nantes, France (submitted from cultivation by Errol Vela) were also studied for comparison purposes. A total of 165 specimens were examined in this study. Relevant Herbarium specimens are deposited in the author’s personal herbarium and in the National Museum of Natural History in Mdina, Malta. Electronic Supplementary File

(ESF) 1 provides information about the material studied including the date of examination, location, (locality and toponym) and the habitat. According to keys and species descriptions by Stearn (1980), Mathew (1996), Aedo Pérez (2014), Tison & al. (2015) and Pignatti (2017), the following set of morphological characters were chosen *a priori* for this study: plant height; width of longest leaf; colour and size of leaf sheath; inflorescence size; proportion of the leaf-sheathing along the stem; presence and morphology of papillae on margin and keel of leaves; colour of tepals and their midvein; size and shape of tepals including the apex; presence and distribution of papillae on tepals; shape and size of tepal's papillae; shape of stamens (filaments and cusps); ratio of the length of the cusps with that of the lamina of inner stamens whorl; the protrusion of anthers from corolla and finally the shape, colour and size of the bulblets. The length of the beak of the spathe was found to be important and measured for a smaller sample of specimens. The most important diagnostic characters used to circumscribe taxa were the foliar and floral papillae, morphology of the stamens (protrusion, shape of stamens and length of cusps) and the shape and size of the bulblets. The flowering time, width of leaves, colour of tepals and length of spathe were of additional support to carry out taxon circumscription.

Results

The character states recorded from 165 specimens are given in the ESF 2. On studying critically the diagnostic characters, four distinct groups (taxonomic units) from wild populations were circumscribed and referred to as P, C, G and Z. The fifth group consisted of cultivated specimens (or escapees) and was labelled as taxon K. A summary of the relationship of these characters and how they were employed to delimit these five taxa is summarised in Table 1, while a detailed account is given below.

Foliar papillae on leaf margins and keel

Seven types of leaf margins labelled A to G have been defined according to the presence, weathering, persistence, continuity, grouping, regularity, size and shape of minute papillae lining the margins and keel of young leaves. Leaf papillae can be classified in two groups: i) types A to C with small, hemispherical or tuberculate papillae not longer than 75 μm and at various levels of weathering - completely weathered or absent in type A to partially preserved in Type C, not detected by the unaided eye (observed under $\times 40$ magnification); and ii) types D to G composed of larger papillae, 100–400(–500) μm and usually visible by the naked eye or a lens; persistent even in old leaves during inflorescence, with various shapes including subspherical and rounded (Type D) to digitiform (Type E) or teat-shaped, hence with a broad base and slightly swollen tips (Type E and F). Leaf margins were found to have either simple and homogenous papillae (Types A to D and Type G) or complex, irregular and grossly heterogenous as in Type F and sometimes in Type E.

The seven types of leaf margins (type A to type G) are illustrated in Fig. 1 and described below:

A: Smooth; margin a narrow hyaline lining without any papillae (Fig. 1a).

B: Subcrenulate; margin almost smooth but with flattened, weathered papillae ($\leq 25 \mu\text{m}$ long) not visible to the unaided eye (Fig. 1b).

Table 1. Main distinctive characters of the five groups recognized.

Diagnostic character	Group P	Group Z	Group G	Group C	Group K
Length of plants (cm)	(15–)50(–100)	(80–)120(–180)	(80–)120(–180)	(60–)100(–150)	70–120
Length of foliar papillae (μm)	25–75	150–250	150–250	100–200	300–450
Weathering of foliar papillae	Yes, leaf margin becomes smooth	No	No	No	No
Shape of foliar papillae	Homogenous, simple, subcylindrical	Heterogenous, various shapes simple and complex forms	Heterogenous, various shapes simple and complex forms	Homogenous, simple, hemispherical, or broadly conical	Homogenous, digitiform
Length of spathe beak (cm)	2–5	6–11	7–13	15–30	Not recorded
Flower colour	Lilac to pale purple	Dark purple	Dark purple	White or pale green	Light purple
Stamen protrusion	Included or partially exerted	Fully exerted	Fully exerted	Fully exerted	Fully exerted
No. of cusps on the internal stamens (Fig. 4)	1 Type A	1(–2) Type A & B	(1–)2–3 Type C & D	(2–)3 Type D (& C)	1 Type A
Papillae on internal tepals (Fig. 9)	Absent or very few	Numerous small papillae throughout entire tepal	Numerous small papillae throughout entire tepal	Numerous small papillae throughout entire tepal	Numerous small papillae throughout entire tepal
Distribution of papillae on tepals (Fig. 9)	Type A	Type C	Type C	Type B	Type D
Bullet shape and size (mm). (Figs. 10 & 11)	Type A, 4–9, homogenous	Type C, 8–18, heterogenous	Type C, 8–18, heterogenous	Type B, 15–35, homogenous	Type B, but less compressed 18–25, homogenous
Seeds	Fertile	Fertile	In majority sterile	Fertile	Not recorded
Flowering period	Beg May to end of May	End May to mid June	Beg/mid June to end of June	End of June to mid July	End May to end June

C: Irregularly subcrenulate-scabridulous; margin with short, narrow conical or subdigitiform papillae, 25–75 μm long, visible with a magnifying glass, often in an irregular or patchy distribution present towards the terminal part of leaf (Fig. 1c).

D: Regularly scabrid by subspherical or widely conical papillae, 100–200 μm long simple, widely spaced, homogenous present along entire margin (Fig. 1d).

E: Regularly denticulate-scabrid by short digitiform to tuberculate papillae, 200–300 μm long, mostly simple, densely packed, homogenous or heterogenous, present along entire margin (Fig. 1e).

F: Irregularly denticulate-scabrid due to a mixture of large, cylindrical, digitiform or tuberculate papillae 200–300 μm long and small, hemispherical or subdigitiform papillae 50–75 μm long, often with irregular and complex papillae, densely packed, heterogenous, present along entire margin (Fig. 1f).

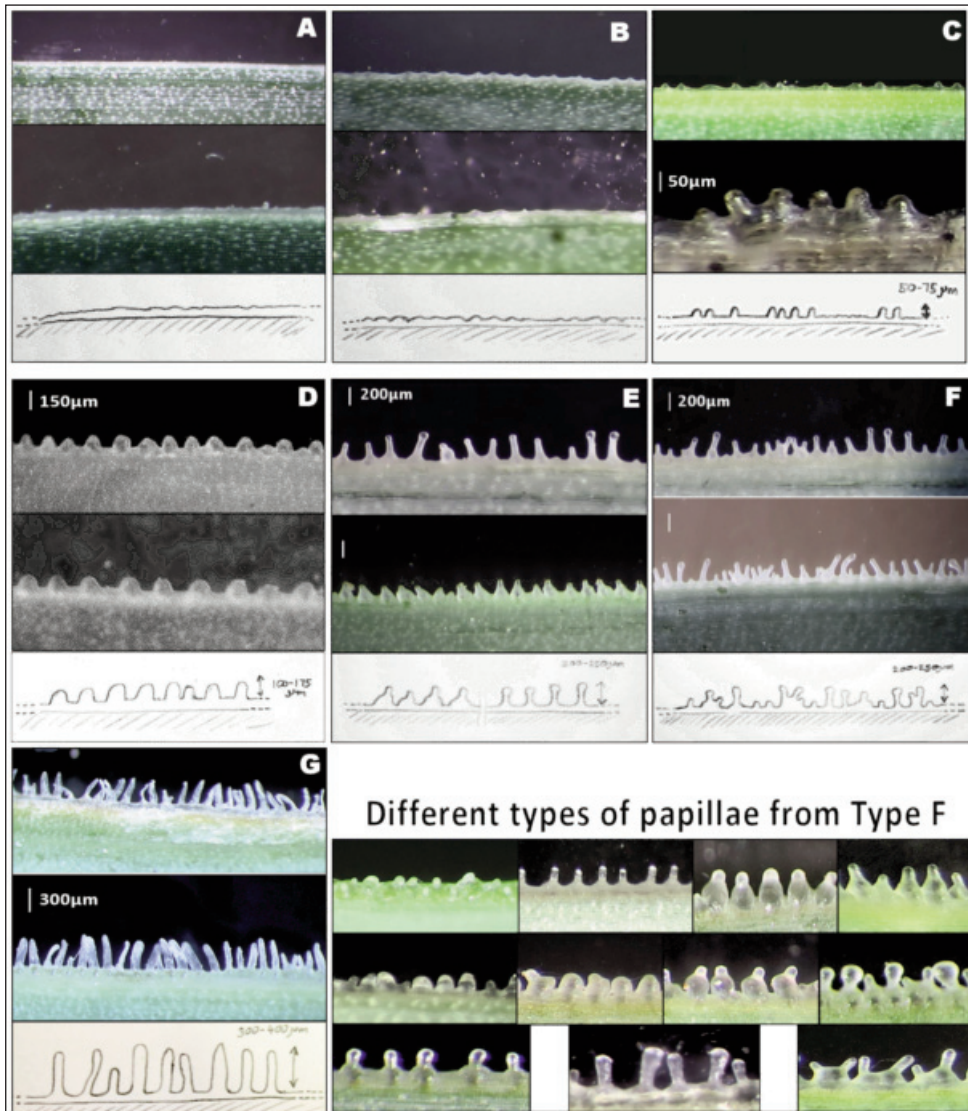


Fig. 1. Different types of leaf margins based on the presence and type of papillae. Type A: smooth (*A. polyanthum*: specimens AS523c, AS524a); Type B: subcrenulate with weathered flat papillae (*A. polyanthum*: specimens BS502b, AS601a); Type C: subcrenulate-scabridulous with small cylindrical papillae, 25–75 µm long (*A. polyanthum*: specimens AS513a, AS513b); Type D: scabrid with spherical papillae, 100–200 µm long (*A. commutatum*: specimen BS627a, CS625a); Type E: regularly denticulate-scabrid with short digitiform to tuberculate papillae, 200–300 µm long, homogenous morphology (*A. commutatum* × *A. polyanthum*: specimen AS601f & BS612a); Type F: irregularly denticulate-scabrid with variously-shaped papillae, 200–300 µm long, heterogenous morphology (*A. commutatum* × *A. polyanthum*: specimen AS601e & BS606a), where the various shapes of papillae observed are illustrated in the bottom right inset; Type G: dentate-subpilose with digitiform papillae, 300–400 µm long (*A. porrum* var. *kurrat*: specimen BS603b & BS606e).

G: Dentate-subpilose with relatively long, slender, digitiform papillae without swollen tips, 300–500 μm long, usually simple, densely packed, homogenous, present along entire margin (Fig. 1g).

Different shapes of papillae have been observed within the examined specimens, but plants in Taxon Z and G had very heterogeneous papillae (Type F) with variable shapes; either observed from different specimens of the same population or along leaf margins of the same specimen. Eight papillae forms have been in fact classified as shown in Fig. 1f: minute-pustulate; slender digitiform; swollen digitiform; hemispherical-doliform; hemispherical with eccentric narrow bulging ends; hemispherical with central wide bulging ends (russian dolls); subcapitate; capitate with swollen heads (teat-shaped); and complex forms with wide bases and 2 or 3 bulging or projecting ends. It is likely that these morphological combinations are the result of the merging of narrow digitiform or pustulate papillae (e.g. Type C) with broad, hemispherical-doliform papillae (e.g. Type D).

Based on foliar papillae, four units were segregated as follows: taxon group P with type A, B, or C papillae (smooth or weathered); taxon group C with type D papillae (homogeneous and persistent); taxon group Z and G with type E or type F papillae (persistent, heterogeneous, simple or complex) and the cultivated taxon group K with type G papillae (very long and subpilose margin).

Plant, leaf and umbel sizes

The examined specimens can be divided into two groups based on the plant height, leaf width and inflorescence sizes. Taxon P made most of one group while taxon C, G, Z and K represented the other group.

Group 1 (taxon P): smaller plants with height of (16–)25–80(–105) cm (=55 cm), (2–)4–12(–20) mm wide (=8.5 mm), and smaller flower-heads measuring (11–)22–48(–66) mm wide (=35 mm);

Group 2 (taxon C, G, Z, and K): larger plants (65–)90–158(–181) cm long (=125 cm), leaves with a pale yellowish-green hue, (12–)16–28(–34) mm wide (=22 mm), and larger flower heads measuring (30–)42–72(–90) mm wide (=57 mm).

Group C from Sicily were at the lower range of group 2 and upper range of group 1. Groups G and Z had the largest plants in terms of plant size, leaf width and flower head diameter.

Stamens: cuspidate filaments and anther protrusion

All examined material was found to have tricuspidate inner stamens with the median cusp being firm and bearing a fertile anther, whereas the lateral cusps were much longer, thread-like, spindly, often found coiled, initially attached with a sterile anther which usually falls prematurely. The lateral cusps were longer than the median by (1.8)–2–4(–4.5) times and could not be used to segregate specimens in any distinct group. However, the ratio of the length of the filament's lamina to the median cusp was more useful, and specimens could be divided into two groups: one group had the lamina subequal or only slightly longer from the median cusp by (0.9–)1.5(–2.0) times; while lamina of the other group was in comparison longer by a ratio of (2.2–)3.0–4.0(4.5). The former group had a more distinct and longer median cusp resulting in the exertion of its anthers well out from the corolla mouth by 2 mm or more. Taxon group C, Z, G and K had this latter type of sta-

mens while taxon group P had shorter median cusps with their anthers at the level of the corolla mouth or just exerted by 1 mm. (Fig. 2).

The amount of protrusion of the anthers out of the urn-shaped or bell-shaped perigone is reported to be a very important character. In this study, it was found that this character is not very easy to assess or reliable because for instance, some flowers had their anthers protruding half-way through the orifice of the corolla mouth, whereas others had stamens protruding marginally by about 1 mm within the same specimen. For consistency this observation is carried out only at pollination. As described in the methodology, stamens had to be exerted by 2 mm or more from the corolla mouth to be classified as exerted anthers, otherwise they were classified as included anthers. Only taxon group P was found to have included anthers.

More important and much easier to evaluate was the variation in the number of cusps observed in the outer whorl of stamens. The studied material could be reliably divided into four groups based on four types of outer stamens labeled Type A, B, C and D as shown in Fig. 3. Type A consisted of specimens with an outer whorl of three simple, completely non-cuspidate, stamens bearing a fertile stamen. Some individuals had monocuspidate stamens but with a small and partial secondary tiny cusp, often detected by a hand lens or magnified images. This is indicated by an arrow in Fig. 3-B3 and 3-B4. Stamens with this morphology were grouped as Type B stamens. Type C stamens had a mixture of two or three cusps (rarely just one) and often with one of the cusps of half or partial length. Leeks with an



Fig. 2. Protrusion of stamens from corolla mouth. A: Included, partially exerted, or shortly exerted by 1 mm (*A. polyanthum*: left BS505a; centre AS524c; right BS512a); B: conspicuously exerted at least by 2 mm (left: *A. commutatum* (CS625a); centre: *A. commutatum* × *A. polyanthum* (BS609a); right: *A. commutatum* (BS627f)).

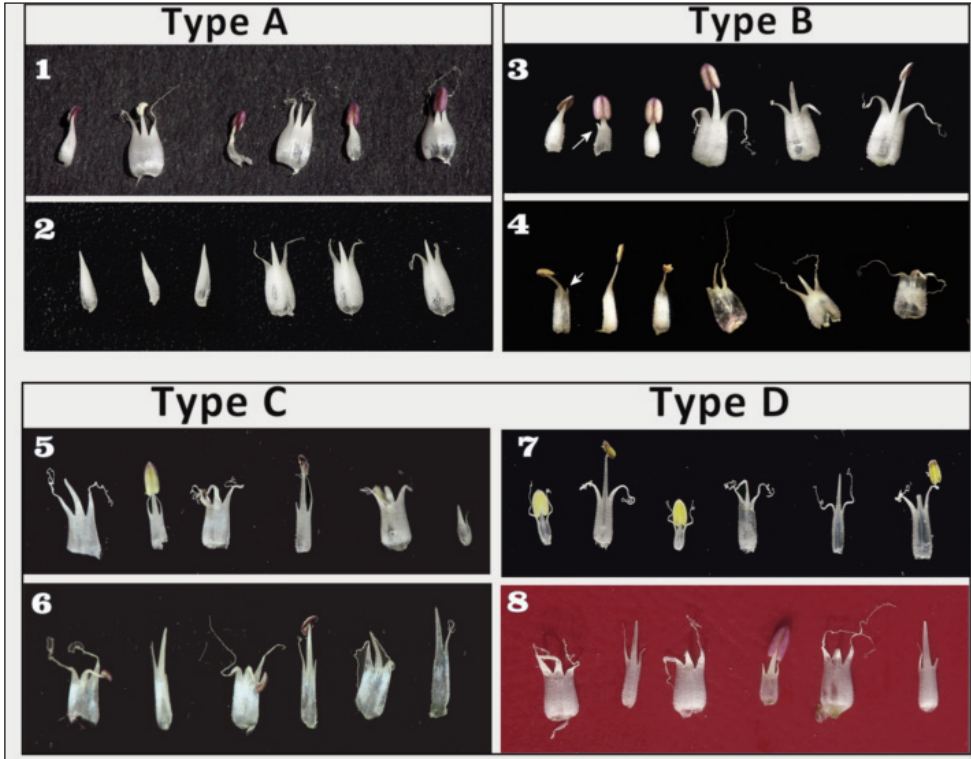


Fig. 3. Stamen morphology. Type A: inner and outer whorls simple and moncuspidate (*A. polyanthum*, top:AS509a; bottom:AS523c); Type B: inner whorl tricuspidate, outer whorl simple and moncuspidate sometimes with a partial lateral cusp (*A. commutatum* × *A. polyanthum*, top:AS601e; bottom:BS606c); Type C: inner whorl tricuspidate, outer whorl with two or three cusps, sometimes with a partial lateral cusp, rarely simple (*A. commutatum* × *A. polyanthum*, top:BS612b; bottom: BS609a); Type D: inner and outer whorls tricuspidate, rarely the outer whorl with a reduced lateral cusp (*A. commutatum*, top:BS627c; bottom:CS625a).

outer whorl of tricuspidate stamens, more or less consistently found so within different flowers were categorized as type D stamens. It is here hypothesized that individuals having Type B stamens with 1-2 cusps or Type C stamens with 2-3 cusps represent an intermediate morphological state between simple moncuspidate stamens (Type A) and tricuspid stamens (Type D).

All specimens within groups P and K had type A stamens, whereas group C and the cultivated specimens had type D stamens. Group Z mostly had type A and type B stamens while group G predominantly had type C stamens (occasionally type D).

Floral papillae

Two types of papillae have been detected: (i) small pustulate papillae 25–40 µm wide, not visible by the naked eye, subcylindrical, slightly longer or subequal to their diameter

and (ii) large papillae (80–)100–150(–170) μm wide, hemispherical, fusiform or compressed conical papillae, shorter than their length. The presence and distribution patterns of these two types of papillae on the external and internal petals are classified in four types as follows (Figs 4 to 8):

Type A: Internal tepals without papillae. External tepals with large papillae, 100–170 μm mostly present on the keel sometimes merging forming ‘walls’, with their frequency decreasing abruptly towards the margin, hence becoming absent at the lateral borders of the tepals. Papillae not numerous and visible to the naked eye mostly compressed spherical-fusiform in shape - Fig. 4 and Fig. 8.

Type B: Internal tepals with small, subcylindrical papillae 25–40 μm wide. External tepals also with similar small papillae, uniformly distributed throughout the entire surface of the tepal. Large papillae absent or few broad, large hemispherical papillae 80–110 μm wide restricted only at a small part of the keel - Fig. 5 and Fig. 8.

Type C: Internal tepals with small, subcylindrical papillae, 25–40 μm wide. External tepals with two types of papillae; small (25–40 μm wide) pustulate papillae uniformly dis-

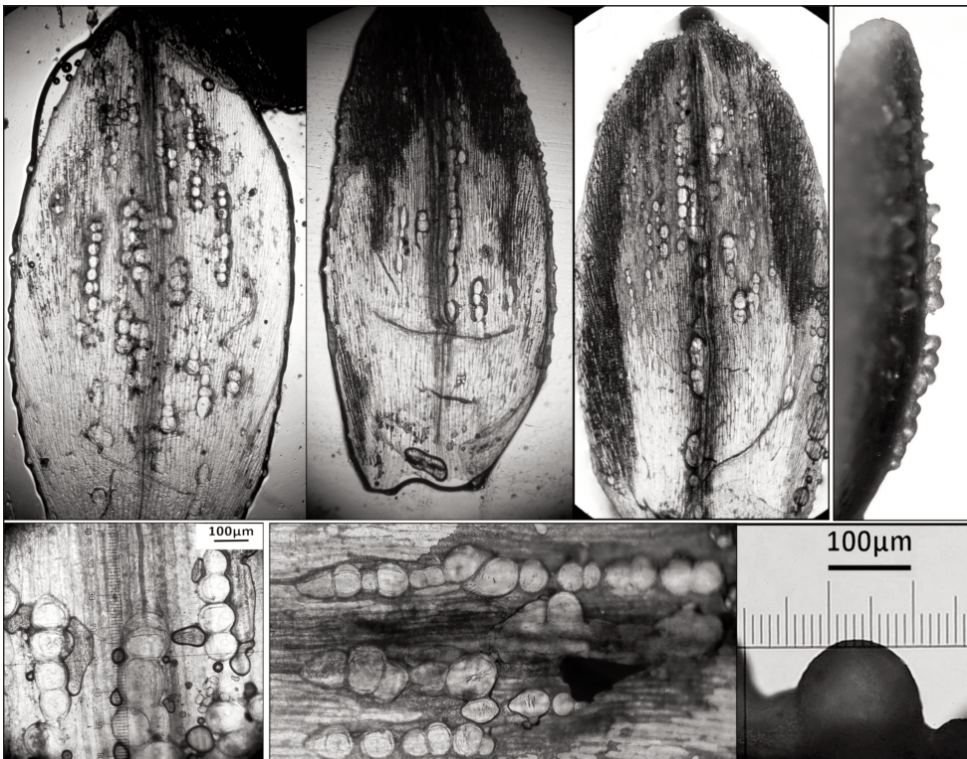


Fig. 4. Type A floral papillae on external tepals of Group P (*Allium polyanthum*), characterised by large hemispherical papillae distributed on and close to the keel, often subfused forming rows or walls, (100–)120–170 μm wide.

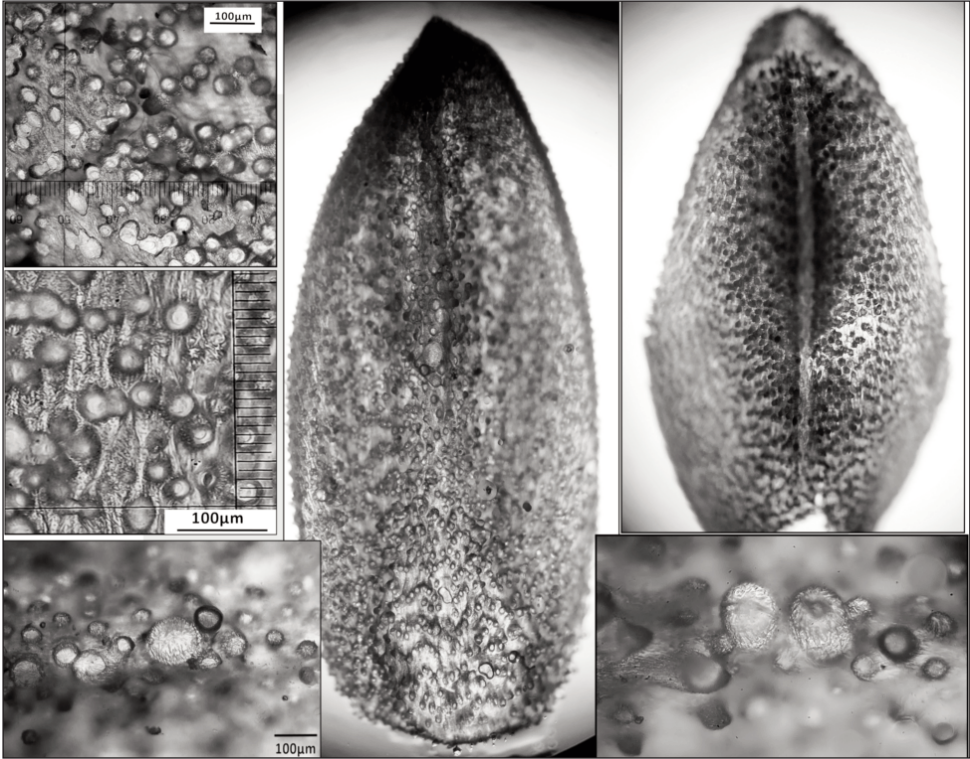


Fig. 5. Type B floral papillae on external tepals of Group C (*Allium commutatum*) characterised by small, 30–40 µm wide papillae evenly distributed throughout the entire surface and occasionally few larger hemispherical to conical papillae on the keel 80–110 µm wide.

tributed throughout the entire tepal and numerous large papillae mostly present on the keel, sometimes merging forming short walls and occupying one third or more of the length of the keel - Fig. 6 and Fig. 8.

Type D: Internal tepals with small, subcylindrical papillae, 25–40 µm wide. External tepals with two types of papillae: small, (25–40 µm wide), pustulate, papillae uniformly distributed throughout the entire surface and large papillae (80–140 µm wide) scattered throughout most of the central part of the tepal hence not restricted only on the keel, sometimes extending up to near the margin of the tepal but then decreasing in size. Papillae numerous and in various sizes with the larger ones present on or close to the keel - Fig. 7 and Fig. 8.

Type B and type C can generally be considered to be similar, but type C have more numerous and larger papillae on the keel, running along at least one third of its length.

The distribution of the papillae on the tepals corresponded with the four groups circumscribed above. All specimens in taxon P had type A floral papillae. Group C primarily had type B papillar distribution on its tepals while that of the cultivated group K was distinctly type D. Plants within taxon group Z and G had type C papillae but some specimens in

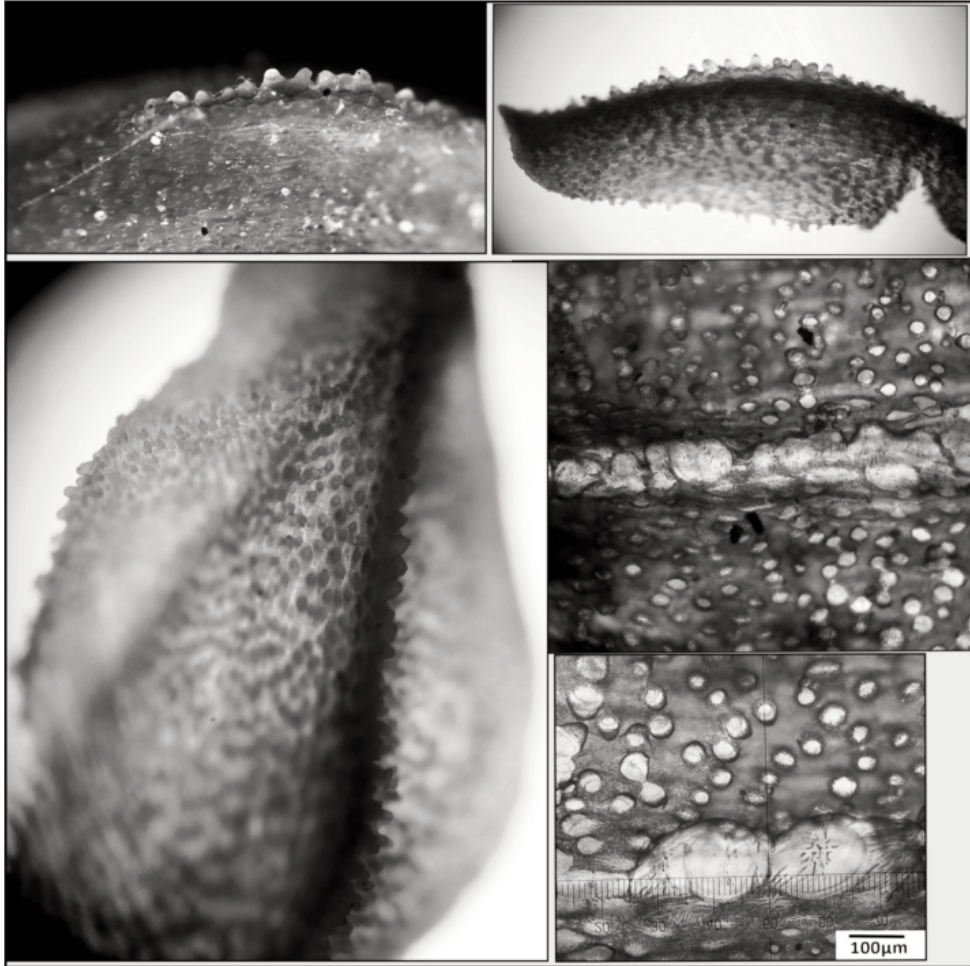


Fig. 6. Type C floral papillae on external tepals of groups G and Z (*Allium commutatum* × *A. polyanthum*) characterised by small, 30–40 µm wide papillae evenly distributed throughout the entire surface and several larger hemispherical to conical papillae on the keel, about 80–150 µm wide, sometimes fused at the base forming papillary walls.

group G occasionally possessed type B papillae but with a tendency of being smaller.

On comparing the four types, here aided by a representative illustration (Fig. 8), it can be preassumed that type C and perhaps Type D are a result of a combination or superimposition of type A and type B papillae.

Bulblet shape

Two main bulblet shapes here referred to as helmet-shape and hemispherical or navicular have been met during this study and labelled as Type A and Type B. Type A bulblets are char-

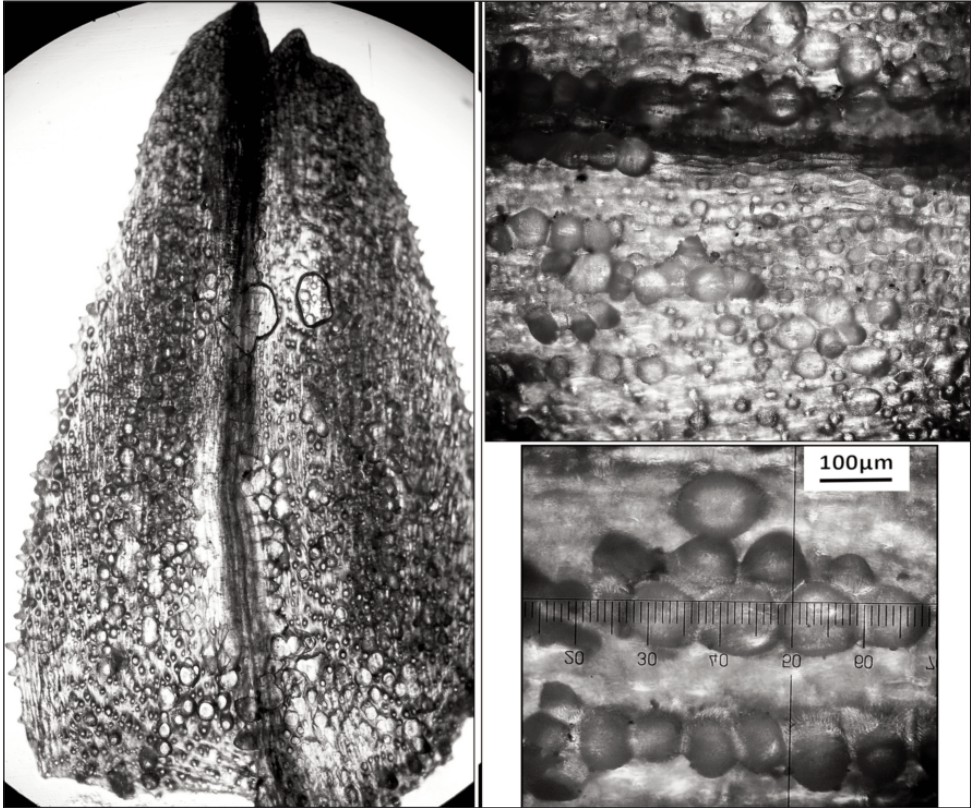


Fig. 7. Type D floral papillae on external tepals of group K (*Allium kurrat* and *A. ampeloprasum*) characterised by small (30–40 µm) and large (80–150 µm) papillae evenly distributed throughout the entire surface but with the large papillae more frequent on and close to the keel and gradually decreasing in size towards the margin.

acterized by sub-globular structures, 4–9 mm in diameter, with a short flattened side at the base hence forming a shape similar to a helmet. The flattened side is only 3–5 mm long and is always shorter from the height or longest diameter of the bulblet body. Type B bulblets have an elongated hemispherical or hemi-ellipsoid structure with acuminate or tapering ends, usually one end more acuminate than the other. The flattened side is longer than the height or width of the bulblet, and can be termed as navicular or compressed fusiform. They vary in size, usually between 10–30(–40 mm) long and 6–12 mm high. Both type A and type B bulblets are homogenous in shape and are illustrated in Fig. 9.

Moreover, a third bulblet morphology has been categorized as Type C which collectively are heterogenous and composed of a mixture of Type A and B bulblets and other bulblets which are considered as a range of intermediates between the two forms, usually hemispherical with a short acuminate end, sometimes compressed and measuring about 12 mm ± 5 mm (Fig. 10).

Specimens within group P produced helmet-shaped (Type A) bulblets whereas those forming group C produced navicular or compressed (Type B) bulblets. Group G and taxon

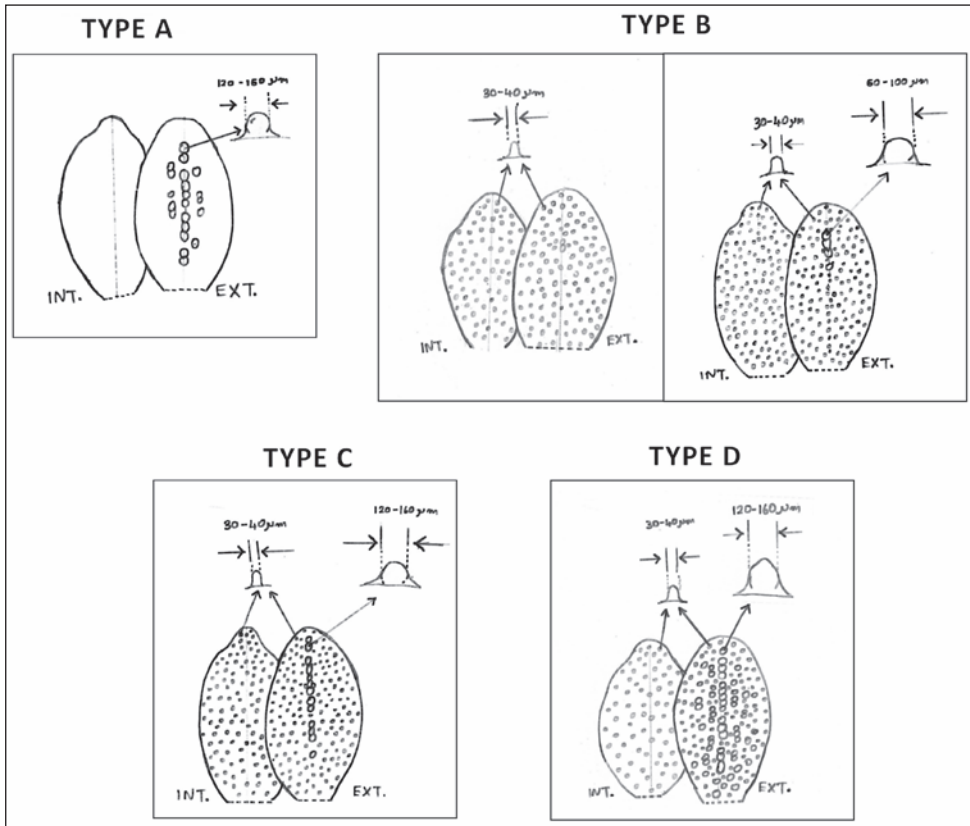


Fig. 8. Representative line diagrams of the four types (Types A to D) of flora papillae on the internal and external tepals.

group Z had heterogenous bulblets (Type C). It was further observed that the Sicilian specimens produced smaller bulblets than the Maltese plants, and that group Z had an elevated number of helmet-shaped bulblets than group G.

Length of beak of the spathe.

Group P had the shortest beaks, typically 2–5 cm long; group C had the longest beaks, 15 cm up to 29 cm in some individuals and groups Z and G had intermediate lengths, normally between 7 cm and 13 cm. In all cases, the spathe splits open from one side and falls down soon after anthesis.

Summary of the circumscribed groups.

Combining the results above, five taxon groups have been circumscribed, four from the wild (groups P, G, Z, C) and one cultivated (group K). Their discriminating characters are summarised in the Table 1.

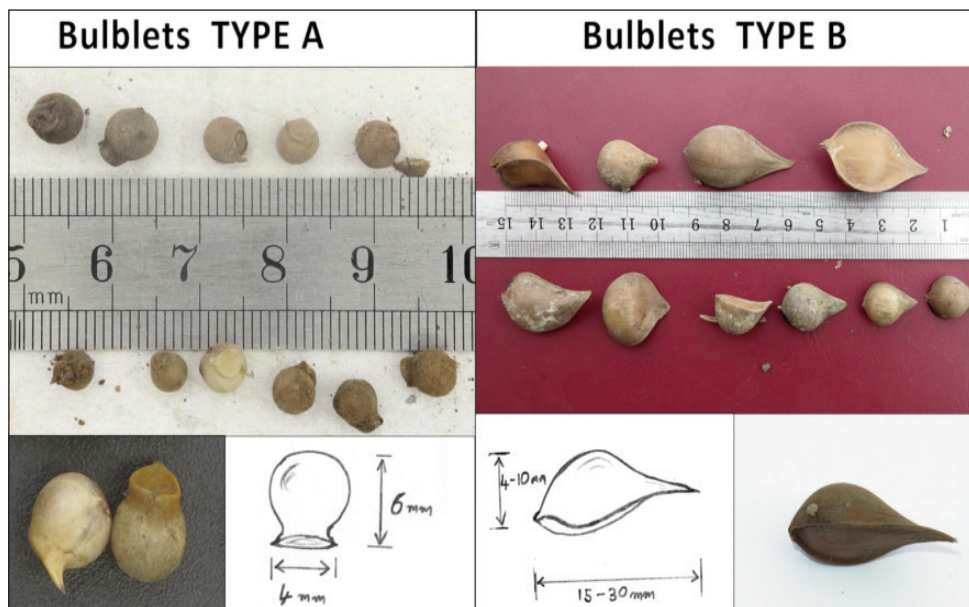


Fig. 9. Two of the three types of bulblet morphology found in the studied specimens. Type A subglobose with a short flat base forming the what so called “helmet” shaped bulblets, 4–9 mm wide (*Allium polyanthum*: specimen AS601a); and Type B with hemispherical to hemi elliptical-fusiform shapes with one end distinctly acuminate, the other shortly acuminate, caudate or obtuse, always longer than high, 15–30(–40) mm long (*Allium commutatum*: specimen CS625b).

Discussion

Identity of group P

Found in exposed rocky patches in garigue, degraded garigue, steppe, abandoned fields, less often in vegetated coastal areas and wasteland, 5–250 m asl. The characters of group P corresponds with *A. polyanthum*. This species is related to *A. ampeloprasum*, but it is a smaller plant, with smooth margins in mature plants due to the quick weathering (or absence) of papillae, have less papillae on the external tepals, and more importantly possess very few or usually complete absence of papillae on the internal tepals.

The classification of *A. polyanthum* is a rather debatable and subjective. Aedo Pérez (2014) followed the classification of De Wilde-Duyfjes (1976); observing plants with intermediate character-states between *A. polyanthum* and *A. ampeloprasum* to co-occur in Spain, their taxonomic treatment was a single, broad *A. ampeloprasum*. Jauzein & Tison (2005) and Tison & al. (2015), consider such intermediates as a hybrid swarm of two distinct subspecies. Jeanmonod & Gamisans (2007), Dobignard & Chatelain (2010) and Flocc’h & al. (2010) also followed this classification. Mathew (1996) considered the distinction wide enough to treat *A. polyanthum*, *A. ampeloprasum* and *A. porrum* L. as distinct species and later they were clearly separated on molecular bases by Hirschegger & al.

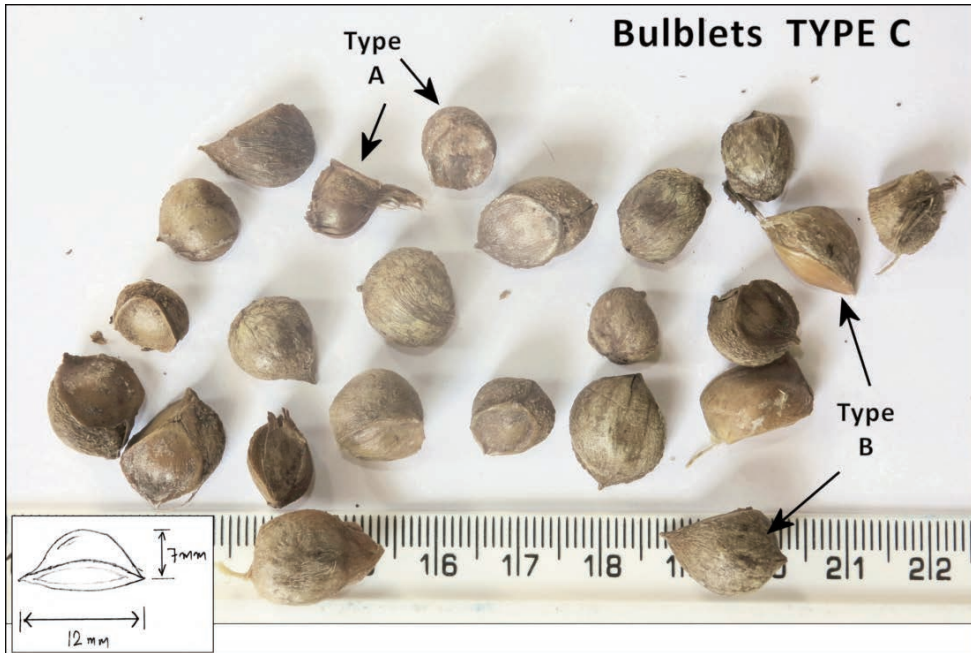


Fig. 10. Type C bulblets composed of mixed Type A and Type B bulblets, and numerous irregular or somewhat intermediate shapes measuring between 7–20 mm long (*A. commutatum* × *A. polyanthum*: specimen AS601e).

(2009). Since our plants are well distinct from the cultivated *A. porrum* s. str. and since specimens showing the characters of *A. ampeloprasum* have not been found, the species rank for *A. polyanthum* is preferred in this work.

The presence of *A. polyanthum* in Malta extends the western distribution of the species, currently occurring in Algeria, Balearic islands, Corsica, France, Italy, Morocco, Sardinia, Spain and Tunisia (GBIF 2017, Euro+Med 2006-2017). However unpublished records from Greece and Crete have been confirmed (pers. comm J-M. Tison).

Identity of group C

Found in littoral habitats, 5-20m asl up to 300m inland. According to the keys and descriptions of Stearn (1980), Mathew (1996), Aedo Pérez (2014), Tison & al. (2015) and Pignatti (2017), group C corresponds perfectly with *A. commutatum*. This species has been confirmed only from Xgħajra at the south east coast of mainland Malta and is to a new record for the Maltese islands. All records of *A. commutatum* for the Maltese Islands in past literature (Lanfranco 1995, Lanfranco & Lanfranco 2003, Mifsud 2002-2014, Bonett & Attard 2005, Weber & Kendzior 2006, Lanfranco 2007, Casha 2013 and Lanfranco & Bonett, 2015) refer to *A. polyanthum* or to groups Z and G for the reported ‘giant forms’ at Filfla and Fungus Rock and nearby mainland shores. The large population at Cava D’Aliga

and the few individuals at Arizzo in Ragusa, Sicily are also *A. commutatum* and were used to compare their characters with the Maltese material. The Maltese population comprises of plants that are distinctly larger from those in Cava D'Aliga but within the variation range of the species and they might be a result of ecotypism or more likely polyploidy. Moreover, all specimens have white tepals instead of pink or purple as it was found at Ragusa, however it is well known that the flower colour of *A. commutatum* vary, and is found either white or deep purple in France and Corsica (sometimes intermixed within the same population) or pink in Greece. The Maltese population exhibit a homogenous morphology.

Identity of groups Z and G and their relationship with A. commutatum

Groups Z and G are found in littoral habitats or abandoned fields near the coast, 5-80 m a.s.l. and are clearly related to *A. commutatum*, but they do not match in a number of characters, the most important being that the internal stamens are never tricuspidate: simple and monocuspidate in group Z, bicuspidate sometimes tricuspidate but with the third cusp partial in group G. Other important differences from *A. commutatum* were observed in the morphology of the papillae of the leaf margin and tepals, the spathe has a shorter beak, the corolla is deep purple, flowering earlier by 3-4 weeks and the bulblets are heterogenous including helmet-shaped and irregular forms as described in detail below and summarised in Table 1.

On evaluating these diagnostic characters, group Z appears to have an array of intermediate characters between *A. polyanthum* (group P) and *A. commutatum* (group C). The type C floral papillae (Fig. 6) of group Z superficially seems to be a direct superimposition of Type A papillae (of *A. polyanthum*) and Type B papillae (of *A. commutatum*). The foliar papillae also seems to be a combined morphology or patten of mixed *A. commutatum* and *A. polyanthum* either in their simple form, hence both papillar forms are found separately on the leaf margin or in a compound or complex form as if having shapes of both papillar types merged together, typically forming broad-based papillae abruptly narrowing to a teat-shaped tip or into capitate heads (Fig. 1f). Bulblets shapes typical of the two species mentioned above were found together in specimens of groups G and Z together with irregularly shaped bulblets judged as intermediate forms. The flowering period (end May to beginning of June) occurs after that of *A. polyanthum* (May) and before *A. commutatum* (end June). The monocuspidate shape of the internal stamens in group Z is a strong character of *A. polyanthum*, while some tricuspidate internal stamens found in group G are typical in *A. commutatum*. The number of bicuspidate internal stamens found in group G (Type C stamens, Fig. 3c) or tiny secondary lateral cusps (tiny appandage) occasionally found in group Z (Type B stamens, Fig. 3b) are considered as an intermediate form between monocuspidate and tricuspidate stamens of *A. polyanthum* and *A. commutatum* respectively. The length of the beak of group G and Z of 6-13 cm is also perfectly intermediate between 2-4 cm in *A. polyanthum* and 12-30 cm in *A. commutatum*.

This morphological study strongly suggest that group Z and group G represent a hybridogeneous population between *A. commutatum* and *A. polyanthum*. As discussed above, both groups either share character states of both parents resulting in an overall heterogenous picture of both states, or have intermediate morphological states between the putative parents or have characters which superficially appears to be a superimposition of character states of the parents. As a result, it is concluded that groups Z and G are likely hybrids: *A. commutatum* × *A. polyanthum*.

Group Z (Żurrieq, southern coast of Malta) show a more balanced character set between the putative parents, while group G (Gozo populations) approaches more to the parent *A. commutatum*, with a later flowering period, smaller papillae on the tepals and 2–3 cusps on the internal stamens. Interestingly, group Z produces fully fertile seeds, but plants of group G in majority are sterile, where the seeds are shrivelled, empty and crumble easily when pressed.

Some individuals within these taxon groups reach up to 180 cm in height, form an umbel the size of a tennis ball, with huge leaves up 4 cm wide and generally very robust plants. These large leeks have also been observed from the islets of Filfla and Fungus rock (Lanfranco 1989; M. Briffa & J. Sultana pers. comm. 2014) and referred to giant forms of *A. commutatum*. Likely, they also represent a well-established hybridogeneous community of *A. commutatum* × *A. polyanthum* as found in the closest shores in mainland Malta and Gozo respectively. Photos of these large leeks growing in Filfla taken by Edwin lanfranco and Joe Sultana are in general identical to groups Z or C, although their details could not be assessed.

Nevertheless, it is safely assumed that Filfla and Fungus Rock harbour an *Allium* population showing features of group Z and group G respectively. Further karyological studies are currently being carried out to confirm the *A. commutatum* ' *polyanthum* hybrid, also detected in south France and North Africa (pers. comm. Errol Vela).

Identity of group K

The cultivated leeks collected from fields in Żurrieq, Xewkija and Mġarr ix-Xini shared the same morphology and were identified as *A. porrum* L. s.l. According to two interviewed farmers their crops correspond to *A. porrum* var. *kurrat* (K. Krause) Seregin. This taxon, forms vigorous plants with thick stems and wide leaves (up to 35 mm broad) with characteristic elongated papillae between 300 and 400 µm long at the margin and keel forming a sub-pilose fringe (Fig. 1g). The tepals have a particular distribution of small and large papillae throughout the external tepals, where the large papillae are not restricted on the keel but occupying most of the face except at the border (Figs 7 & 8: type D). On examining material of *A. ampeloprasum* submitted to us from France, the same type of distribution was observed concluding that these cultivars maintained these diagnostic characters from *A. ampeloprasum* from which they originate. *A. porrum* and *A. porrum* var. *kurrat* have not been found naturalising rocky habitats away from their source of cultivation or known to form any populations except some casual escapees close to field margins. As a result they should be treated as agricultural crops and not to be included in flora of the Maltese Islands.

What is *Allium melitense*?

A. melitense (Sommier & Caruana) Cif. & Giacom. was described as a small variety of *A. ampeloprasum*. According to this revision they correspond to the lower small-sized individuals within group P with all diagnostic characters identical to the larger plants of this group. Therefore, no taxonomic distinction could be found plausible as has already been suspected by Mifsud (2011).

In the early 20th century, *A. ampeloprasum* was thought to occur in steppic and garigue communities in Malta. Being by description a rather large species (80-180 cm high), the

small-sized *Allium* individuals may have contrasted with *A. ampeloprasum* and merited to be described as a distinct small variety (*A. ampeloprasum* var. *melitense*). But since now it is established that the Maltese plants are *A. polyanthum* - a species with a height of 15–100 cm, these small plants fall within the lower range of *A. polyanthum*, hence resulting that *A. melitense* has no particular distinction. Individuals with a very small habit, flowerheads (2 cm across), bulblets (4–5 mm) and bulbs (8–12 mm) are considered to be small ecotypes of *A. polyanthum* occurring in very degraded areas or in restricted volume of soil in pockets of karst rock.

The fact that the size of the plant and flower head have no taxonomic importance was demonstrated in situ in several occasions. A clump of twelve plants found at Wied Diegu, Żurrieq (Fig. 11) were composed both of normal sized plants ('*A. ampeloprasum*') and small-sized plants ('*A. melitense*'). The May-flowering Maltese population contributes to a continuous range of sizes within the species concept of *A. polyanthum*. Such small plants have also been observed in France intermixed with *A. polyanthum* (pers. comm. Errol Vela, 2014). As a result, *A. melitense* and *A. ampeloprasum* subsp. *melitense* should be treated as synonyms of *A. polyanthum*.

***Allium ampeloprasum* and its status in Malta**

A. ampeloprasum had been recorded from the Maltese islands in historical literature, until it was gradually substituted by *A. commutatum* (Lanfranco 1989). To verify that none of our studied material correspond to *A. ampeloprasum* and since the distinction in literature (eg. Stearn 1980; Mathew 1996, etc) is based on an unclear character of stamen exertness, a voucher specimen of *A. ampeloprasum* kindly submitted by Errol Vela was studied and compared with the collected material. The diagnostic characters differed from those found in all Maltese collections but related to specimens from or close to cultivated areas which in this study corresponded to *A. porrum* var. *kurrat*. This taxon is often found in synonym with *A. ampeloprasum* or as its infraspecific rank (ThePlantList 2013), although it is considered distinct by some authors for being a cultivated leek with wider leaves and larger bulbets (Mathew 1996). The shape, distribution and morphology of the floral papillae of *A. ampeloprasum* was for example similar to *A. porrum* var. *kurrat*, but slightly smaller and longer than it is wide, hence more conical in shape. Therefore, since *A. ampeloprasum* was not collected from natural habitats it is suggested to be removed from the current flora of the Maltese Islands and historical records likely referred to *A. polyanthum* or its hybrid with *A. commutatum*.

Specimens from the southeast coast of Sicily

On June 2015, a sizeable population of *A. commutatum* was found east of Cava' d'Aliga beach on vegetated coastal rock, a few metres away from the sea. This population was composed of several hundreds of individuals in three separate clumps very close to each other. On comparing with the Maltese population (Fig. 12), the Sicilian plants were in general smaller and had pinkish tepals. A higher frequency of slightly larger papillae on the

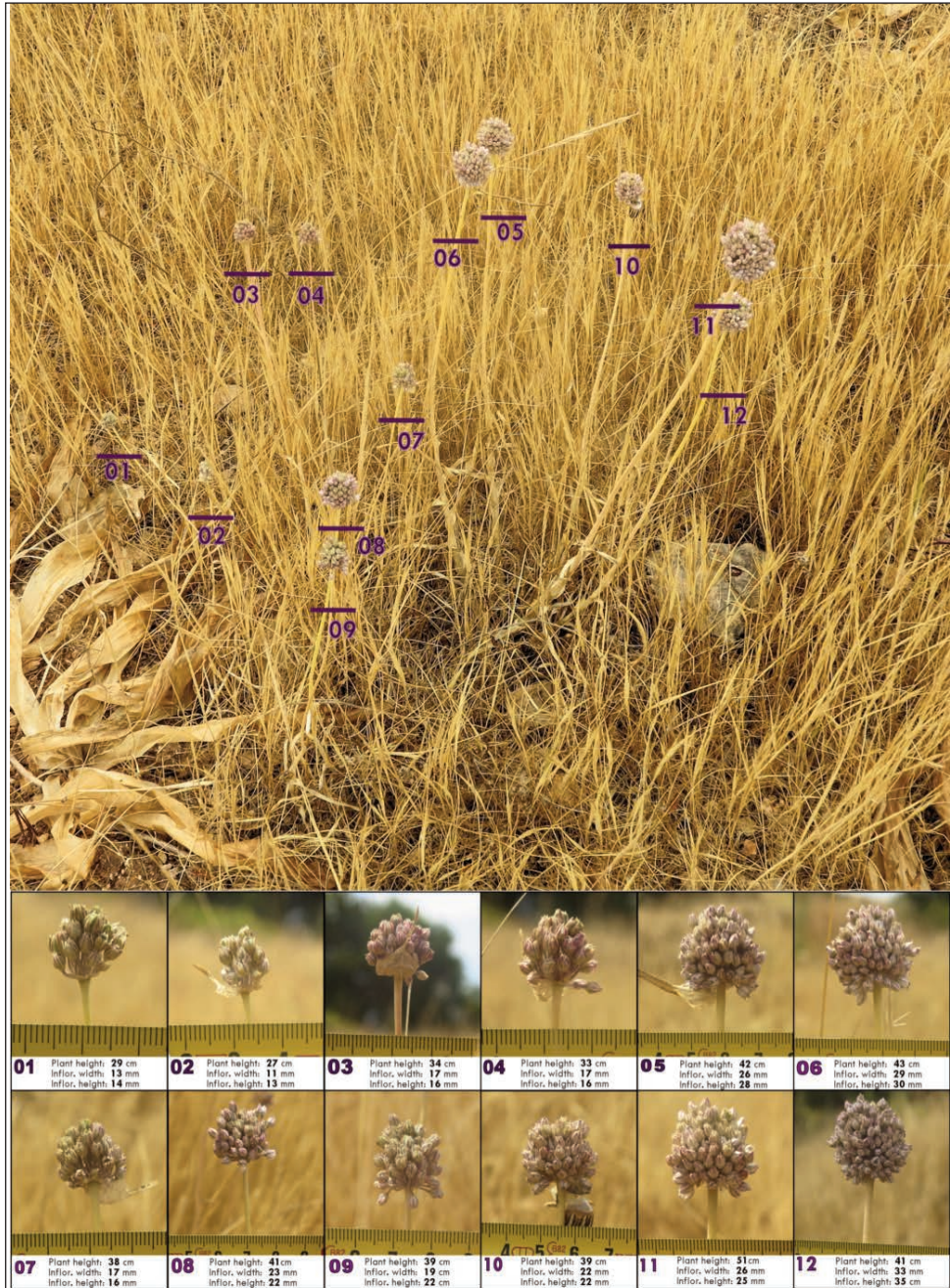


Fig. 11. Clump of twelve individuals of *Allium polyanthum* at Wied Diego, Żurrieq (1 June 2014) and their plant height and inflorescence size clearly showing that some measurements are within the species concept of the presumed endemic *A. melitense*, distinct and described for its small stature and hemispherical inflorescences less than 3 cm wide.

keel of the external tepals was observed, but then not as numerous or large as in the hybrid taxa (groups G and Z).

Five individuals of *A. polyanthum* were found at Spiaggia Bruca, close to Arizza beach, in their developed but still closed fruit. It is assumed that their flowering period was several weeks prior to this observation, hence in mid May. Despite the fact that these examples were quite dry, they had leaves with a smooth leaf margin, Type A floral papillae and small helmet-shaped bulblets. Previous notes to the name *A. polyanthum* in Sicily, as synonym of *A. ampeloprasum*, can be found in Giardina & al. (2007). The record of this species for Sicily is included in the recent checklist of the Flora of Italy (Bartolucci & al. 2018).

Three individuals *Allium* sp. were found close to Marina di Modica, in a degraded vegetated littoral ground. They had very young pale green fruits and few old, shrivelled flowers indicating that the flowering period occurred a few weeks before, more or less in mid June. The leaf margin had half-weathered but distinct papillae; the outer stamens tricuspidate, inner stamens simple and monocuspidate; floral papillae Type C but with some large papillae spread away from the keel in few tepals and numerous heterogeneous bulblets with helmet-like, hemispherical and irregular (angular) shapes as in Type C bulblets (Fig. 10) This character set approaches that of *A. commutatum* ' *polyanthum*. This is the first record for Sicily and Italy according to Giardina & al. (2007) and Brullo & Guarino (2017). Bartolucci & al. (2018) does not includes hybrids. Further investigations are needed to clarify its distribution in Sicily.

***Allium* section *Allium* subsect. *Scoroprasum* on the Maltese Islands**

A. polyanthum Schult. & Schult. f. Syst. Veg. 7: 1016 (1830)

= *A. ampeloprasum* var. *melitense* Sommier & Caruana Gatto; = *A. melitense*. (Sommier & Caruana Gatto) Ciferri & Giacomini

Common in Malta, Gozo, Comino and other islets (Mifsud 2011; Mifsud & al. 2016), probably also present in the islets of Filfla and General's rock (Fungus rock). Habitat: steppe and degraded garigue, but sometimes also in wasteground, abandoned clayey fields (usually forming larger plants), and rarely in littoral areas. Native.

A. commutatum Guss. Enum. Pl. Inarim. 339 (1855)

Very rare and confirmed from the location at Xgħajra, Malta, and very recently found at Saint Paul's Bay. Habitat: disturbed coastal rocky ground. Native, threatened by human disturbance, future or illegal development, alien species, massive collection of waste dumping and recreational activities close to the sea. It is suggested to include this species in the future edition or the Red List for the Maltese Islands.

A. commutatum* × *A. polyanthum

Rare but locally frequent in established populations at the coast of Wied iz-Żurrieq, Wied Babu and Blue Grotto, Żurrieq in mainland Malta and at Dwejra, Xlendi and San Dimitri in Gozo. Large individuals recorded from the islets of Filfla and General's rock (Fungus rock), (Lanfranco 1989; pers. comm. Michael Briffa and Joe Sultana) are likely other established hybridogenous populations. Habitat: coastal rocky ground and steppe. Native.



Fig. 12. Photos comparing the umbel, corolla and floral papillae of the external tepals of: 1. *A. polyanthum* (Mġarr ix-Xini, Ta' Sannat, Gozo, 23 May 2014); 2. *A. commutatum* (Xghajra, 25 June 2016); 3. *A. commutatum* × *A. polyanthum* (Wied iż-Żurriq, 6 June 2015) from the Maltese Islands and 4. *A. commutatum* (Cava d'Aliga, 27 June 2015) from the southeast coast of Sicily.

Identification key to species of Allium subsect. Allium in Malta

1. Leaf margin subpillose with long digitate papillae more than 400 µm long. Only cultivated ***A. porrum* var. *kurrat***
1. Leaf margin smooth or with shorter conical papillae reaching up to 300 µm long. Wild, native or naturalised. **2**
2. Stamens included, same level of corolla mouth or slightly exerted by 1 mm; leaf margins smooth (papillae absent) or rarely crenulate with weathered flattened papillae <100 µm long; inner tepals without or with very few papillae..... ***A. polyanthum***
2. Stamens fully exerted by 2 mm or more above the corolla mouth; leaf margins scabrid by persistent papillae, usually visible by naked eye (>150 µm long) even in mature individuals; inner tepals densely papillose and punctate. **3**
3. Outer tepals with numerous large papillae (>80 µm) distributed throughout most of the tepal except at the border and small papillae (20–40 µm) spread throughout the entire surface. Inner stamens always simple and monocuspitate. ***A. ampeloprasum***
3. Outer tepals without or with few large papillae (>80 µm) present only on the keel and small papillae (20–40 µm) spread throughout the entire surface. Inner stamens tricuspidate or bicuspidate (very rarely monocuspidate.) **4**
4. Inner stamens mostly tricuspidate; outer tepals without large (>80 µm) papillae, or if present occupying less than third of the keel; bulblets homogenous all fusiform-elleipsoid, with a long tapering end; spathe beak >15 cm long..... ***A. commutatum***
4. Inner stamens either simple, or mixed bicuspidate and tricuspidate but never all tricuspidate; tepals with large distinct papillae (>80µm) on at least one third of the length of the keel; bulblets heterogenous; spathe beak usually < 15 cm long.
..... ***A. commutatum* × *A. polyanthum***

Conclusion

This study on *Allium* subsection *Allium* has brought important changes for the flora of Malta, which so far relied on historical flora (e.g. Sommier & Caruana Gatto 1915; Borg 1927; Haslam & al. 1977). The study on 165 specimens from 59 populations resulted in the occurrence of three recognised taxa in the Maltese Islands: *A. polyanthum* (very common), *A. commutatum* (very rare) and their hybrid *A. commutatum* × *A. polyanthum* (rare). *A. melitense* is now treated as synonym of *A. polyanthum* while *A. ampeloprasum* was not found in the examined material and most probably is not present in natural habitats in Malta.

Despite these novelties, more karyological work is required to establish the chromosome numbers of these population especially for the two hybrid populations in the Maltese islands, where the Gozitan population was found to be sterile while that from Żurrieq in mainland Malta produced many sterile seeds.

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Address of the authors:

Stephen Mifsud* & Owen Mifsud,

Gardenia, Triq il-Batterija, Santa Venera, SVR1430, Malta. Email: info@maltawild-plants.com

*Corresponding author

Sampled material with Accession number, Locality, Collecting date, collector (SM= Stephen Mifsud, OM= Owen Mifsud) and Habitat.

Sample No.	Island	Locality	Toponym	Collection Date	Leg.	Habitat
AS509a	Gozo	Qala	Tac-Cawla	09/05/2014	SM	Steppic to degraded garigue habitat, fields (some abandoned) in close vicinity
AS513a	Malta	St. Julians	Wied Harq Hammiem	13/05/2014	SM	Degraded garigue with many ruderals and steppic communities
AS513b	Malta	St. Julians	Wied Harq Hammiem	13/05/2014	SM	
AS513c	Malta	St. Julians	Wied Harq Hammiem	13/05/2014	SM	
AS514a	Malta	Zurrieq	Wied Diegu	14/05/2014	SM	Garigue very close to the cliffs
AS523a	Gozo	Sannat	Wied Mgarr ix-Xini (north side)	23/05/2014	SM	Rocky valley side with shrubby labiates, <i>Erica multiflora</i> and <i>Euphorbia</i> spp
AS523b	Gozo	Sannat	Wied Mgarr ix-Xini (north side)	23/05/2014	SM	
AS523c	Gozo	Sannat	Wied Mgarr ix-Xini (north side)	23/05/2014	SM	
AS523d	Gozo	Sannat	Wied Mgarr ix-Xini (north side)	23/05/2014	SM	
AS523e	Gozo	Sannat	Wied Mgarr ix-Xini (north side)	23/05/2014	SM	
AS523f	Gozo	Sannat	Wied Mgarr ix-Xini (north side)	23/05/2014	SM	
AS524a	Gozo	San Lawrenz	Ponta ta' Harrux	24/05/2014	SM	Coastal and rupestral rocky ground abundant with <i>Globigerina</i> limestone substrate
AS524b	Gozo	San Lawrenz	Ponta ta' Harrux	24/05/2014	SM	
AS524c	Gozo	San Lawrenz	Ponta ta' Harrux	24/05/2014	SM	Abandoned terraces fields about 150m away from the coast with steppic communities
AS524d	Gozo	San Lawrenz	Ponta ta' Harrux	24/05/2014	SM	
AS524e	Gozo	San Lawrenz	TA' Kurrat	24/05/2014	SM	Disturbed and stoney clayey soil close to the coast
AS524f	Gozo	Fontana	Close to Ghar tal-Hasselin	24/05/2014	SM	Low rocky bank near a small street in shallow soil pockets in karstic rock
AS524g	Gozo	Xlendi	Torri tax-Xlendi	24/05/2014	SM	Disturbed clayey soil on a coastal rocky bank with compact, stoney deep soil
AS524h	Gozo	Xlendi	Torri tax-Xlendi	24/05/2014	SM	
AS524i	Gozo	Munxar	Wied tal-Kantra	24/05/2014	SM	Rocky valley side with clayey and rather deep soil (many ruderals and ermes present)
AS524j	Gozo	Munxar	Sanap Cliffs	24/05/2014	SM	Garigue close to coastal cliffs (c. 120m asl) Rock exposed with shallow soil
AS528a	Malta	Zurrieq	Wied Diegu	28/05/2014	SM	Exposed rocky areas with arid and shallow soil in a garrigue dominated with <i>Erica multiflora</i> and labiates
AS528b	Malta	Zurrieq	Wied Diegu	28/05/2014	SM	
AS529a	Malta	Rabat	Tafal Tal-Virtu (l/o Verdala)	29/05/2014	SM	Fields on clay slopes facing North East
AS529b	Malta	Rabat	Tafal Tal-Virtu (l/o Verdala)	29/05/2014	SM	Fields on clay slopes facing North East
AS529c	Malta	Rabat	Tafal Tal-Virtu (l/o Verdala)	29/05/2014	SM	Fields on clay slopes facing North East
AS529d	Malta	Rabat	Tafal Tal-Virtu (l/o Verdala)	29/05/2014	SM	Fields on clay slopes facing North East
AS601a	Malta	Zurrieq	Wied Fulija	01/06/2014	SM	Coastal garigue on cliff margin Rock exposed or with shallow soil prone to wind and rain erosion Flora typically garigue, but degraded and characterised by xerophytic plants
AS601b	Malta	Zurrieq	Wied Fulija	01/06/2014	SM	
AS601c	Malta	Zurrieq	Wied Fulija	01/06/2014	SM	
AS601d	Malta	Zurrieq	Wied Fulija	01/06/2014	SM	Abandoned fields with steppic vegetation
AS601e	Malta	Zurrieq	Wied Babu, l/o Blue Grotto	01/06/2014	SM	Disturbed garigue at the border of coastal cliffs
AS601f	Malta	Zurrieq	Wied Babu, l/o Blue Grotto	01/06/2014	SM	
AS612a	Gozo	Gharb	San Dimitri	12/06/2014	SM	Roadside below rubblewall of a field accompanying by ruderals
AS612b	Gozo	Gharb	San Dimitri	12/06/2014	SM	Abandoned fields with deep clayey soil accompanied with many thistles and steppic species
AS612c	Gozo	Gharb	San Dimitri	12/06/2014	SM	
AS614a	Gozo	San Lawrenz	TA' Kurrat	14/06/2014	SM	
AS614b	Gozo	San Lawrenz	TA' Kurrat	14/06/2014	SM	Coastal cliffs facing north characterised with a mosaic community of garigue and litoral species Soil sandy, loamy, not compact and damp
AS614c	Gozo	San Lawrenz	TA' Kurrat	14/06/2014	SM	Arid ground mostly of <i>Globigerina</i> limestone with deep soil
AS614d	Gozo	San Lawrenz	Dwejra chapel	14/06/2014	SM	
AS614e	Gozo	Gharb	Wied il-Milied	14/06/2014	SM	
AS614f	Gozo	Gharb	Wied il-Milied	14/06/2014	SM	
AS614g	Gozo	Gharb	Wied il-Milied	14/06/2014	SM	
AS614h	Gozo	Gharb	Wied il-Milied	14/06/2014	SM	
AS614i	Gozo	Gharb	Wied il-Milied	14/06/2014	SM	Steppe within derelict fields close to the coast and a small valley Soil stoney, clayey and quite deep
AS617a	Gozo	Xlendi	Xlendi tower	17/06/2014	SM	Coastal habitat, ground rich in <i>globigerina</i> limestone, soil compact, stoney and propably shallow Few vegetation around mostly <i>Limbarda crithmioides</i> (L.) Dumort and <i>Salsola melitensis</i> Botschantzev
AS617b	Gozo	Xlendi	Xlendi tower	17/06/2014	SM	
AS617c	Gozo	Xlendi	Xlendi tower	17/06/2014	SM	
AS617d	Gozo	Xlendi	Xlendi tower	17/06/2014	SM	
AO514a	Malta	Mellieha	Red Tower area	14/05/2014	OM	Fallow field with dry and rather shallow soil
AO514b	Malta	Mellieha	Red Tower area	14/05/2014	OM	Arid steppe with dry shallow soil and short grass
AO516a	Malta	Pembroke	Pembroke garigue	16/05/2014	OM	
AO516b	Malta	Pembroke	Pembroke garigue	16/05/2014	OM	Steppe
AO517a	Malta	St. Paul's Bay	Qortin	17/05/2014	OM	
AO517b	Malta	St. Paul's Bay	Qortin	17/05/2014	OM	Sloped valley bank close to water course with rather deep soil
AO518a	Malta	Mosta	Wied Speranza	18/05/2014	OM	
AO518b	Malta	Mosta	Wied Speranza	18/05/2014	OM	Fallow fields and dry steppe
AO520a	Malta	Naxxar	Tal-Wej	20/05/2014	OM	
AO520b	Malta	Naxxar	Tal-Wej	20/05/2014	OM	Rocky valley bank just above valley bed
AO524a	Malta	Rabat	Wied il-Qlejgha (fiddien side)	24/05/2014	OM	
AO524b	Malta	Rabat	Wied il-Qlejgha (fiddien side)	24/05/2014	OM	Dry steppe with dry shallow soil
AO528a	Malta	Qrendi	Ghar Lapsi	28/05/2014	OM	
AO528b	Malta	Qrendi	Ghar Lapsi	28/05/2014	OM	
AO528c	Malta	Qrendi	Wied iz-Zurrieq	28/05/2014	OM	
AO528d	Malta	Qrendi	Wied iz-Zurrieq	28/05/2014	OM	
AO528e	Malta	Qrendi	Wied iz-Zurrieq	28/05/2014	OM	
AO529a	Malta	Rabat	Migra l-Ferha car park area	29/05/2014	OM	Along pathway in a dry disturbed steppe-like garigue
AO529b	Malta	Rabat	Migra l-Ferha car park area	29/05/2014	OM	Near pathway in dry arid steppe
AO529c	Malta	St. Julians	Wied Harq Hammiem	29/05/2014	OM	Karstic rock of coralline limestone garigue which is degraded and overrun by ruderals
AO529d	Malta	St. Julians	Wied Harq Hammiem	29/05/2014	OM	
AO602a	Malta	Attard	Wied Encita	02/06/2014	OM	Degraded garigue close to a valley bank
AO602b	Malta	Attard	Wied Encita	02/06/2014	OM	Steppe
AO602c	Malta	Zebbug	Wied Qirda	02/06/2014	OM	Deep clayey soil of a fallow field
AO604a	Malta	Dingli	near Maddalena chapel	04/06/2014	OM	Steppe or very degraded garigue close to the cliffs

AO604b	Malta	Dingli	near Maddalena chapel	04/06/2014	OM	Cliff edge facing southwest
AO605a	Malta	Gharghur	Wied Anglu	05/06/2014	OM	Steppe in shallow arid soil
AO605b	Malta	Gharghur	Wied Anglu	05/06/2014	OM	
AO607a	Gozo	Iz-Zebbug	Between Wied I-Ghasri and Qbajjar	07/06/2014	OM	Arid, dry, sloping steppe close to the coast with shallow soil
AO607b	Gozo	Iz-Zebbug	Between Wied I-Ghasri and Qbajjar	07/06/2014	OM	
AO616a	Malta	Siggiewi	near San Blas chapel	16/06/2014	OM	Margins of an field with deep soil
AO617a	Malta	Siggiewi	Fawwara	17/06/2014	OM	Karstic rock of a degraded garigue
AO617b	Malta	Qrendi	Wied iz-Zurrieq	17/06/2014	OM	Garigue not far from the coast
AO617c	Malta	Qrendi	Wied iz-Zurrieq	17/06/2014	OM	
BS502a	Sicily	St. Paul's Bay	Selmunett	02/05/2015	SM	
BS502b	Sicily	St. Paul's Bay	Selmunett	02/05/2015	SM	
BS502c	Sicily	St. Paul's Bay	Selmunett	02/05/2015	SM	
BS502d	Sicily	St. Paul's Bay	Selmunett	02/05/2015	SM	
BS502e	Sicily	St. Paul's Bay	Selmunett	02/05/2015	SM	
BS502f	Sicily	St. Paul's Bay	Selmunett	02/05/2015	SM	
BS504a	Comino	Comino	Bungalow area	04/05/2015	SM	Arid coastal steppe, (with remnants of phryganae)
BS504b	Comino	Comino	Bungalow area	04/05/2015	SM	
BS505a	Malta	Mellieha	Cirkewwa (Paradise Bay area)	05/05/2015	SM	Exposed rocky garigue with shallow compact soil close to the coast
BS505a	Malta	Mellieha	Cirkewwa (Paradise Bay area)	05/05/2015	SM	
BS506a	Malta	MarsaScala	Zonqor Point	06/05/2015	SM	Vegetated coastal garigue
BS512a	Gozo	Xewkija	Wied Mgarr ix-Xini	12/05/2015	SM	Exposed garigue with low shrubs
BS512b	Gozo	Xewkija	Wied Mgarr ix-Xini	12/05/2015	SM	
BS512c	Gozo	Xewkija	Wied Mgarr ix-Xini	12/05/2015	SM	
BS513a	Malta	St. Paul's Bay	San Martin	13/05/2015	SM	Garigue to phryganae
BS513b	Malta	Naxxar	Gebel San Pietru	13/05/2015	SM	Exposed arid rocky ground in a habitat dominated by pre-desert scrub
BS513c	Malta	Naxxar	Gebel San Pietru	13/05/2015	SM	Sloped rocky ground in a garigue (rather degraded)
BS514a	Malta	Naxxar	Wied Anglu	14/05/2015	SM	Arid phrygana-garigue habitat at valley side
BS514b	Malta	Naxxar	Wied Anglu	14/05/2015	SM	
BS515a	Malta	Naxxar	Bahar ic-Caghaq	15/05/2015	SM	Disturbed rocky ground fragmented littoral vegetation very close to the coast
BS515b	Malta	Naxxar	Bahar ic-Caghaq	15/05/2015	SM	
BS515c	Malta	Naxxar	Bahar ic-Caghaq	15/05/2015	SM	
BS518a	Malta	Rabat	Tal-Virtu	18/05/2015	SM	Clayey fields
BS518b	Malta	Rabat	Tal-Virtu	18/05/2015	SM	
BS520a	Malta	Rabat	Mtahleb (valley area)	20/05/2015	SM	Arable fields close to water course
BS520b	Malta	Rabat	Mtahleb (valley area)	20/05/2015	SM	
BS520c	Malta	Rabat	Mtahleb (steppe near church)	20/05/2015	SM	
BS520d	Malta	Rabat	Mtahleb (steppe near church)	20/05/2015	SM	Steppe dominated by grasses and thistles
BS520e	Malta	Rabat	Mtahleb (steppe near church)	20/05/2015	SM	
BS520f	Malta	Dingli	Faqqanija	20/05/2015	SM	
BS520g	Malta	Dingli	Faqqanija	20/05/2015	SM	Exposed rocky land composed of a mosaic of phryganae and garigue
BS523a	Malta	Rabat	Mtahleb	23/05/2015	SM	Valley side with characteristic garigue to pre desert scrub vegetation
BS525a	Gozo	Fontana	Wied il-Lunzjata	25/05/2015	SM	Agricultural waste dumped in valley side Purely casual specimen growing in the wild
BS527a	Gozo	Sannat	Ta' Cenc	27/05/2015	SM	Low garigue
BS527b	Gozo	Sannat	Ta' Cenc	27/05/2015	SM	Low garigue
BS528a	Gozo	Qala	Hondoq ir-Rummien	28/05/2015	SM	Arid low garigue with steppic interferences
BS601a	Malta	Qrendi	Hagar Qim	01/06/2015	SM	Garigue close to the cliff edge, quite bare, arid and shallow soil
BS601b	Malta	Qrendi	Hagar Qim	01/06/2015	SM	
BS601c	Malta	Qrendi	Mnajdra area	01/06/2015	SM	Garigue close to the cliff edge, quite bare, arid and shallow soil
BS601d	Malta	Qrendi	Mnajdra area	01/06/2015	SM	
BS603a	Gozo	Xewkija	Fields along main road	03/06/2015	SM	Cultivated fields
BS603b	Gozo	Xewkija	Fields along main road	03/06/2015	SM	
BS603c	Gozo	Xewkija	Fields near Mgarr Xini	03/06/2015	SM	
BS603d	Gozo	Xewkija	Fields near Mgarr Xini	03/06/2015	SM	
BS606a	Malta	Qrendi	Wied iz-Zurrieq	06/06/2015	SM	Rocky passage close to a field and bare rocky ground about 200m from the coast
BS606b	Malta	Qrendi	Wied iz-Zurrieq	06/06/2015	SM	Abandoned terraced fields
BS606c	Malta	Qrendi	Wied iz-Zurrieq	06/06/2015	SM	
BS606d	Malta	Qrendi	Wied iz-Zurrieq	06/06/2015	SM	
BS606e	Malta	Qrendi	Wied iz-Zurrieq	06/06/2015	SM	
BS606f	Malta	Qrendi	Wied iz-Zurrieq	06/06/2015	SM	Rocky valley bank with garigue vegetation
BS606g	Malta	Qrendi	Wied iz-Zurrieq	06/06/2015	SM	Arid rocky ground in a degraded garigue with few shallow soil pockets
BS608a	Gozo	Zebbug	Wied I-Infern	08/06/2015	SM	Cultivated fields
BS609a	Gozo	Gharb	Wied Mielah	09/06/2015	SM	Abandoned terraced field about 400m from the coast
BS609b	Gozo	Gharb	Wied Mielah	09/06/2015	SM	
BS609c	Gozo	Gharb	Wied Mielah	09/06/2015	SM	
BS612a	Gozo	Xlendi	Torri tax-Xlendi	12/06/2015	SM	Coastal steppe and calcareous rocky ground
BS612b	Gozo	Xlendi	Torri tax-Xlendi	12/06/2015	SM	
BS612c	Gozo	Xlendi	Torri tax-Xlendi	12/06/2015	SM	
BS620a	Gozo	Xlendi	Torri tax-Xlendi	20/06/2015	SM	
BS627a	Sicily	Scicli	Cava d'Aliga	27/06/2015	SM	Littoral rocky steppe very close to the coast Large population of about a thousand specimens fragmented in three metapopulations
BS627b	Sicily	Scicli	Cava d'Aliga	27/06/2015	SM	
BS627c	Sicily	Scicli	Cava d'Aliga	27/06/2015	SM	
BS627d	Sicily	Scicli	Cava d'Aliga	27/06/2015	SM	
BS627e(i)	Sicily	Scicli	Cava d'Aliga	27/06/2015	SM	
BS627e(ii)	Sicily	Scicli	Cava d'Aliga	27/06/2015	SM	
BS627f(i)	Sicily	Scicli	Cava d'Aliga	27/06/2015	SM	
BS627f(ii)	Sicily	Scicli	Cava d'Aliga	27/06/2015	SM	
BS628a	Sicily	Scicli	Arizza	28/06/2015	SM	Very disturbed rocky ground with deep slightly sandy soil between the coast and urban areas
BS628b	Sicily	Scicli	Arizza	28/06/2015	SM	
BS628c	Sicily	Scicli	Arizza	28/06/2015	SM	
BS628d	Sicily	Scicli	Marina di Modica	28/06/2015	SM	Disturbed coastal rocky ground
CO517a	Malta	Marsaxlokk	Kalanka - Delimara	17/05/2016	OM	Very disturbed steppe (with few garigue remnants) close to the coast
CO517b	Malta	Marsaxlokk	Xrobb I-Ghagin	17/05/2016	OM	Coastal garigue with shallow, dry soil
CO517c	Malta	Marsaxlokk	Tas-Silg area	17/05/2016	OM	Along the main road of Delimara
CO524	Malta	Mgarr	Ghajn Tuffieha	24/05/2016	OM	Coastal dry garigue, very few individuals along a pathway
CS625a	Malta	Xghajra	Xatt tax-Xghajra	25/06/2016	SM & OM	Very disturbed steppic area (almost a wasteland) close to the coast
CS625b	Malta	Xghajra	Xatt tax-Xghajra	25/06/2016	SM & OM	
CS625c	Malta	Xghajra	Xatt tax-Xghajra	25/06/2016	SM & OM	
CS625d	Malta	Xghajra	Xatt tax-Xghajra	25/06/2016	SM & OM	
CS625e	Malta	Xghajra	Xatt tax-Xghajra	25/06/2016	SM & OM	
CS625f	Malta	Xghajra	Xatt tax-Xghajra	25/06/2016	SM & OM	Disturbed coastal rocky ground overrun by alien species
CS625g	Malta	Xghajra	Xatt tax-Xghajra	25/06/2016	SM & OM	

Synoptic table of measured morphological characters.

Sample No.	Plant height (cm)	Sheath colour	Sheath length (mm)	Width of longest leaf (mm)	Inflorescence height (mm)	Inflorescence width (mm)	Proportion of stem with leaves	Presence of visible papillae on old leaves	Leaf margin (macroscopical examination)	Papillae type on leaf margin	Length of leaf papillae or hyaline margin (μm)	Colour of Tepals (colour index 0-5)	Tepals length (mm)	Tepals Width (mm)	Apex of Tepals	Type of distribution of papillae on tepals	Arrangement of Cusps on Stamens	Length ratio of lateral cusp to median cusp of inner stamens	Ratio of filament lamina to median cusp	Protrusion of anthers from corolla	Bulbet shape	Average length of bulblets (mm)	Length of largest bulblet (mm)
AS509a	100	n.e.	n.e.	14	56	47	½	No	Smooth or subcrenulate with flattened, weathered papillae	B		Pink (2)	4.5	2	Obtuse	A	A	× 4	× 4	Included or partially exerted	Helmet or subspherical (Type A)	n.e.	n.e.
AS513a	85	n.e.	n.e.	11	38	44	½ – ¾	No	Scabridulous by minute papillae on the terminal part of young leaves, sometimes in an irregular or patchy distribution	C	75	Pink (2)	4.5	2	Sub-acute to obtuse	A	A	× 3.5	×3.5	Included or partially exerted	Helmet or subspherical (Type A)	9.5	11.0
AS513b	72	n.e.	n.e.	7	39	44	½	No	Scabridulous by minute papillae on the terminal part of young leaves, sometimes in an irregular or patchy distribution	C	75–100	Pink (2)	4	1.5	Obtuse with a short mucro	A	A	×3.0	×3.0	Included or partially exerted	Helmet or subspherical (Type A)	8.5	10.0
AS513c	30	n.e.	n.e.	3	14	19.5	½	No	Smooth or subcrenulate with flattened, weathered papillae	B		Purple (3)	4	1.5	Obtuse	A	A	× 4	×2.5	Included or partially exerted	Helmet or subspherical (Type A)	3.5	5.0
AS514a	25	n.e.	n.e.	3	10	13	½ – ¾	No	Smooth or subcrenulate with flattened, weathered papillae	B		Pink (2)	4	2	Sub-acute with a small blunt mucro.	A	A	× 3	×3.0	Included or partially exerted	Helmet or subspherical (Type A)	5.5	7.0
AS523a	63	n.e.	n.e.	8	41	42	½	No	Scabridulous by minute papillae on the terminal part of young leaves, sometimes in an irregular or patchy distribution	C	75	Pink (2)	4.5	2	Obtuse	A	A	× 4	×2.5	Included or partially exerted	Helmet or subspherical (Type A)	7.0	8.0
AS523b	79	n.e.	n.e.	11	50	48	½	No	Smooth, margin a narrow hyaline lining	A		Pink (2)	4.5	2	Obtuse	A	A	× 3	×2.5	Included or partially exerted	n.e.	n.e.	n.e.
AS523c	28	n.e.	n.e.	5	22	24	½ – ¾	No	Smooth, margin a narrow hyaline lining	A		Pink (2)	4	1.5	Obtuse to subtruncate	A	A	× 2	×3.0	Included or partially exerted	n.e.	n.e.	n.e.
AS523d	17	n.e.	n.e.	3.5	15	18	½	No	Smooth, margin a narrow hyaline lining	A		Purple (3)	4	2	Subacute - Obtuse	A	A	× 2.5	×3.0	Included or partially exerted	n.e.	n.e.	n.e.
AS523e	38	n.e.	n.e.	5	26	30	½	No	Scabridulous by minute papillae on the terminal part of young leaves, sometimes in an irregular or patchy distribution	C	75–100	Lilac (1) becoming whitish	4.5	2	Obtuse	A	A	× 2	×3.0	Included or partially exerted	Helmet or subspherical (Type A)	4.5	6.5
AS523f	28	n.e.	n.e.	4.5	21	24	½	No	Smooth, margin a narrow hyaline lining	A		Purple (3)	4.5	2	Obtuse	A	A	-	-	Included or partially exerted	n.e.	n.e.	n.e.
AS524a	80	n.e.	n.e.	14	37	41	½	No	Smooth, margin a narrow hyaline lining	A		Pink (2)	5	2	Subacute, some with a small blunt	A	A	× 3	×3.0	Included or partially exerted	n.e.	n.e.	n.e.
AS524b	67	n.e.	n.e.	9	49	45	½	No	Smooth or subcrenulate with flattened, weathered papillae	B		Light pink - lilac (1)	4.5	2	Broadly acute to subtruncate	A	A	× 3	×2.5	Included or partially exerted	Helmet or subspherical (Type A)	6.5	5.5
AS524c	87	n.e.	n.e.	16	61	63	½	No	Smooth, margin a narrow hyaline lining	A		Lilac	4.5	2	Obtuse	A	A	× 2.5	×2.0	Included or partially exerted	n.e.	n.e.	n.e.
AS524d	80	n.e.	n.e.	12	48	47	½	No	Scabridulous by minute papillae on the terminal part of young leaves, sometimes in an irregular or patchy distribution	C	50–75	Pink (2)	4.5	2	Obtuse	A	A	× 3	×2.5	Included or partially exerted	n.e.	9.8	10.5
AS524e	37	n.e.	n.e.	8	24	29	½	No	Smooth, margin a narrow hyaline lining	A		Lilac	5	1.5	Subacute	A	A	× 3	×3.0	Included or partially exerted	n.e.	n.e.	n.e.
AS524f	40	n.e.	n.e.	6	22	28	½	No	Smooth, margin a narrow hyaline lining	A		Pink	4	2	Subacute, few with a small tiny blunt tip	A	A	× 2.5	×3.0	Included or partially exerted	n.e.	n.e.	n.e.
AS524g	65	n.e.	n.e.	9.5	39	37	½	No	Smooth or subcrenulate with flattened, weathered papillae	B		Pink	4.5	2	Obtuse. Few tepals with a small tiny	A	A	× 3	×3.5	Included or partially exerted	Helmet or subspherical (Type A)	7.5	7.0
AS524h	69	n.e.	n.e.	13	45	44	½ – ¾	No	Smooth or subcrenulate with flattened, weathered papillae	B		Pink	4	2	Subacute	A	A	× 3	×3.5	Included	n.e.	n.e.	n.e.
AS524i	83	n.e.	n.e.	10	57	51	½	No	Smooth, margin a narrow hyaline lining	A		Pink (2)	4.5	2	Subacute to obtuse	A	A	× 3	×3.0	Included or partially exerted	n.e.	n.e.	n.e.
AS524j	28	n.e.	n.e.	5	15	20	½	No	Smooth, margin a narrow hyaline lining	A		Lilac (1)	4.5	2	Obtuse with a short blunt tip	A	A	× 3	×3.0	Included or partially exerted	n.e.	n.e.	n.e.
AS528a	22	n.e.	n.e.	3	17	22	½	No	Smooth, margin a narrow hyaline lining	A		Lilac (1)	4	1.5	Obtuse	A	A	× 2.5	×3.5	Included or partially exerted	n.e.	n.e.	n.e.

AS528b	79	n.e.	n.e.	11	50	48	½	No	Smooth, margin a narrow hyaline lining	A		Lilac (1)	4.5	2	Obtuse	A	A	× 2.5	×3.5	Included or partially exerted	Helmet or subspherical (Type A)	6.5	6.0
AS529a	100	n.e.	n.e.	-	65	58	½	No	Leaf not available	-		Pale pink (1)	4.5	2	Obtuse - subacute	A	A	× 2.5	×3.5	Included or partially exerted	n.e.	n.e.	n.e.
AS529b	95	n.e.	n.e.	-	58	50	½	No	Leaf not available	-		Purple-pink (2)	4.5	2	Obtuse - subacute	A	A	× 3.5	×3.0	Included or partially exerted	Helmet or subspherical (Type A)	7.5	9.0
AS529c	100	n.e.	n.e.	13	70	60	½	No	Smooth or subcrenulate with flattened, weathered papillae	B		Purple-pink (2)	4.5	2	Obtuse - subacute	A	A	× 3	×3.0	Included or partially exerted	Helmet or subspherical (Type A)	10.5	9.5
AS529d	105	n.e.	n.e.	-	60	58	½	No	Leaf not available	-		Pale pink (1)	4.5	2	Obtuse	A	A	× 4	×3.0	Included or partially exerted	Helmet or subspherical (Type A)	10.5	9.0
AS601a	18	n.e.	n.e.	3	13	18	½	No	Smooth or subcrenulate with flattened, weathered papillae	B		Pale pink (1)	4	2	Obtuse to subacute in some tepals	A	A	× 4	×2.5	Included or partially exerted	n.e.	n.e.	n.e.
AS601b	28	n.e.	n.e.	3.5	15	20	½	No	Smooth or subcrenulate with flattened, weathered papillae	B		Pale pink (1)	4	2	Obtuse	A	A	× 3	×2.5	Included or partially exerted	Helmet or subspherical (Type A)	5.0	7.0
AS601c	26	n.e.	n.e.	5	22	25	½	No	Smooth or subcrenulate with flattened, weathered papillae	B		Purple-pink (2)	4	2	Subacute	A	A	× 2.5	×3.5	Included or partially exerted	n.e.	n.e.	n.e.
AS601d	43	n.e.	n.e.	8	31	29	½	No	Smooth, margin a narrow hyaline lining	A		Pale pink (1)	4	1.5	Obtuse to subacute in some tepals	A	A	× 2	×3.0	Included or partially exerted	n.e.	n.e.	n.e.
AS601e	111	n.e.	n.e.	20	54	55	½	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	F	200–250	Purple, rather dark (3)	3.5	1.7	Acute (sub-truncate) with a small blunt	C	B	× 2	× 1.5	Fully exerted by 2–3mm	Helmet or subspherical (Type A)	12.0	15.0
AS601f	145	n.e.	n.e.	20	69	71	½	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	E	200–250	Purple, rather dark (3)	3.5	2	Acute (sub-truncate) with a small blunt	C	A + B	× 3.5	× 1.6	Fully exerted by 2–3mm	n.e.	n.e.	n.e.
AS612a	90	n.e.	n.e.	13	50	53	½ – ¾	No	Smooth, margin a narrow hyaline lining	A	200–250	Lilac (1)	3.5	1.5	Obtuse to blunt (sub-acute)	A	A	× 3	× 2.1	Included	n.e.	n.e.	n.e.
AS612b	100	n.e.	n.e.	20.5	52	50	½	No	Smooth or subcrenulate with flattened, weathered papillae	B	200–250	Pink (2)	4	2	Obtuse, sometimes sub-acute or	A	A	× 3	×2.5	Included or partially exerted	Helmet or subspherical (Type A)	7.0	9.0
AS612c	40	n.e.	n.e.	5	26	24	½ – ¾	No	Leaf not available	X	200–250	Lilac (1)	4	2	Subacute	A	A	× 3.5	×2.5	Included or partially exerted	n.e.	n.e.	n.e.
AS614a	140	n.e.	n.e.	31	49	54	½	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	E	200–250	Purple-mauve (3)	3.5	2	Subacute	C	C	× 3.5	×1.2	Fully exerted	n.e.	n.e.	n.e.
AS614b	135	n.e.	n.e.	26	46	50	½	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	E	200–250	Purple-mauve (3)	4	2	Subacute	B/C	C	× 4.5	×1.2	Fully exerted	n.e.	n.e.	n.e.
AS614c	122	n.e.	n.e.	18	43	47	½	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	E	200–250	Purple-mauve (3)	4	2	Subacute	B	C	× 3.2	×1.3	Fully exerted	Helmet or subspherical (Type A)	12.0	16.0
AS614d	164	n.e.	n.e.	34	71	72	½	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	E	200–250	Purple-mauve (3)	4	2	Acute	C	C	×2.7	×0.8 (lamina shorter from cusp)	Fully exerted	n.e.	n.e.	n.e.
AS614e	139	n.e.	n.e.	21	51	54	½	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	E	200–250	Purple-mauve (3)	3.5	2	Subacute	B	C	× 4.0	×1.6	Fully exerted	n.e.	n.e.	n.e.
AS614f	134	n.e.	n.e.	21	51	56	½	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	E	200–250	Purple-mauve (3)	4	2	Subacute	B	C	× 2.8	×1.2	Fully exerted	n.e.	n.e.	n.e.
AS614g	122	n.e.	n.e.	19.5	45	48	½	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	E	200–250	Purple-mauve (3)	4	2	Subacute	B	C	× 2.9	×1.1	Fully exerted	n.e.	n.e.	n.e.
AS614h	138	n.e.	n.e.	22	47	50	½	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	E	200–250	Purple-mauve (3)	4	2	Subacute	B	C	× 2.6	×0.8 (lamina shorter from cusp)	Fully exerted	n.e.	n.e.	n.e.
AS614i	147	n.e.	n.e.	24.5	64	68	½ – ¾	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	E	200–250	Purple-mauve (3)	4	2	Subacute	C	C	× 3.0	×1.2	Fully exerted	Helmet or subspherical (Type A)	13.0	16.0
AS617a	82	n.e.	n.e.	18	40	44	½	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	E	200–250	Purple-mauve (3)	3.5	1.5	Subacute ending with a short mucro	B	C	× 4.0	×1.4	Fully exerted	n.e.	n.e.	n.e.
AS617b	106	n.e.	n.e.	25	44	48	½	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	E	200–250	Purple-mauve (3)	4	2	Subacute, ending with a short mucro	B	C	× 3.1	×1.0	Fully exerted	Helmet or subspherical (Type A)	12.0	15.0
AS617c	121	n.e.	n.e.	18	44	49	½	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	E	200–250	Purple-mauve (3)	4	2	Subacute, ending with a short mucro	C	C	× 4.0	×1.2	Fully exerted	n.e.	n.e.	n.e.
AS617d	165	n.e.	n.e.	27	72	75	½	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	E	200–250	Purple-mauve (3)	4	2	Subacute, ending with a short mucro	B	C	×3.5	×1.0	Fully exerted	Helmet or subspherical (Type A)	10.0	14.0
AO514a	53	n.e.	n.e.	4	29	32	¾	No	Smooth or subcrenulate with flattened, weathered papillae	B	200–250	Pink	4	2	Obtuse	A	A	×2	×4	Included or partially exerted	n.e.	n.e.	n.e.
AO514b	51	n.e.	n.e.	-	33	38	-	No	Smooth or subcrenulate with flattened, weathered papillae	B	200–250	Pink	4	2	Obtuse	A	A	×2	×4	Included or partially exerted	Helmet or subspherical (Type A)	6.0	7.0

AO516a	47	n.e.	n.e.	6	43	21	¼	No	Smooth or subcrenulate with flattened, weathered papillae	B	200–250	Pink	5	2	Obtuse	A	A	x2	x4	Included or partially exerted	n.e.	n.e.	n.e.
AO516b	39	n.e.	n.e.	4	39	30	¼	No	Smooth or subcrenulate with flattened, weathered papillae	B	200–250	Pink	5	2	Obtuse	A	A	x2	x4	Included or partially exerted	Helmet or subspherical (Type A)	5.0	7.0
AO517a	56	n.e.	n.e.	7	42	35	¼	No	Smooth or subcrenulate with flattened, weathered papillae	B	200–250	Pink	4	2	Obtuse	A	A	x2	x4	Included or partially exerted	n.e.	n.e.	n.e.
AO517b	29	n.e.	n.e.	3	21	26	¼	No	Smooth or subcrenulate with flattened, weathered papillae	B	200–250	Pink	5	2	Obtuse	A	A	x2	x4	Included	Helmet or subspherical (Type A)	6.0	7.0
AO518a	90	n.e.	n.e.	11	47	56	½–¾	No	Smooth or subcrenulate with flattened, weathered papillae	B	75–250	Pink	4.5	2	Obtuse	A	A	x2	x4	Included or partially exerted	Helmet or subspherical (Type A)	8.0	10.0
AO518b	95	n.e.	n.e.	12.5	43	51	-	No	Smooth or subcrenulate with flattened, weathered papillae	B	75–250	Pink	5	2	Obtuse	A	A	x2	x4	Included or partially exerted	n.e.	n.e.	n.e.
AO520a	70	n.e.	n.e.	7	40	48	¼	No	Smooth or subcrenulate with flattened, weathered papillae	B	200–250	Pink	4	2	Obtuse	A	A	x2	x4	Included or partially exerted	Helmet or subspherical (Type A)	5.5	8.0
AO520b	88	n.e.	n.e.	9	35	47	½–¾	No	Smooth or subcrenulate with flattened, weathered papillae	B		Pink	4	2	Obtuse	A	A	x2	x4	Included or partially exerted	n.e.	n.e.	n.e.
AO524a	88	n.e.	n.e.	-	75	31	-	No	Smooth or subcrenulate with flattened, weathered papillae	B		Pink	4.5	2	Obtuse	A	A	x2	x4	Included or partially exerted	n.e.	n.e.	n.e.
AO524b	50	n.e.	n.e.	9	57	26	¼	No	Smooth or subcrenulate with flattened, weathered papillae	B		Pink	4.5	1.5	Obtuse	A	A	x2	x4	Included or partially exerted	n.e.	n.e.	n.e.
AO528a	32	n.e.	n.e.	4	21	28	¼	No	Smooth or subcrenulate with flattened, weathered papillae	B		Pink	4.5	2	Obtuse	A	A	x2	x4	Included or partially exerted	n.e.	n.e.	n.e.
AO528b	31	n.e.	n.e.	4	26	25	½–¾	No	Smooth or subcrenulate with flattened, weathered papillae	B		Pink	5	2	Obtuse	A	A	x2	x4	Included	Helmet or subspherical (Type A)	4.0	6.0
AO528c	137	n.e.	n.e.	18	53	52	¼	Yes	Scabrid margin composed of mixed types of papillae: short knobby papillae (75–100 long) and cylindrical to finger-shaped papillae (250). Distribution of papillae	F	150–250	Dark purple (4)	4.5	2	Obtuse	C	A + B	x2.2	x1.5	Fully exerted by 2–3mm	n.e.	n.e.	n.e.
AO528d	177	n.e.	n.e.	25	67	65	¼–½	Yes	Scabrid margin composed of mixed types of papillae: short knobby papillae (75–100 long) and cylindrical to finger-shaped papillae (250). Distribution of papillae	F	100–250	Dark purple (4)	4.5	2	Obtuse	C	A	n.e.	n.e.	Fully exerted by 2–3mm	n.e.	n.e.	n.e.
AO528e	107	n.e.	n.e.	26	47	43	-	Yes	Scabrid margin composed of mixed types of papillae: short knobby papillae (75–100 long) and cylindrical to finger-shaped papillae (250). Distribution of papillae	F	75–200	Dark purple (4)	4.5	2	Obtuse	C	A	n.e.	n.e.	Fully exerted by 2–3mm	Mixed shapes (Type C)	12.0	14.0
AO529a	86	n.e.	n.e.	14	52	43	-	No	Scabridulous by minute papillae on the terminal part of young leaves, sometimes in an irregular or patchy distribution	C	50	Pink	4	2	Obtuse	A	A	x2	x4	Fully exerted	n.e.	n.e.	n.e.
AO529b	53	n.e.	n.e.	6	45	33	¼	No	Smooth, margin a narrow hyaline lining	A		Pink	5	2	Obtuse	A	A	x2	x4	Included or partially exerted	Helmet or subspherical (Type A)	4.0	5.0
AO529c	91	n.e.	n.e.	11	61	62	¼	No	Smooth or subcrenulate with flattened, weathered papillae	B		Pink	4	2	Obtuse	A	A	x2	x4	Included or partially exerted	n.e.	n.e.	n.e.
AO529d	52	n.e.	n.e.	5	45	40	½–¾	No	Scabridulous by minute papillae on the terminal part of young leaves, sometimes in an irregular or patchy distribution	C	50–75	Pink	5	2	Obtuse	A	A	x2	x4	Included or partially exerted	Helmet or subspherical (Type A)	4.0	5.5
AO602a	99	n.e.	n.e.	20.5	52	56	½–¾	No	Smooth, margin a narrow hyaline lining	A		Pink	5	2	Obtuse	A	A	x2	x3	Included or partially exerted	n.e.	n.e.	n.e.
AO602b	58	n.e.	n.e.	7	36	38	½–¾	No	Smooth or subcrenulate with flattened, weathered papillae	B		Pink	4	2	Obtuse	A	A	x2	x4	Included or partially exerted	Helmet or subspherical (Type A)	n.e.	8.0
AO602c	63	n.e.	n.e.	6	31	22	-	No	Smooth or subcrenulate with flattened, weathered papillae	B		Pink	4	2	Subacute	A	A	x1.5	x4	Included or partially exerted	n.e.	n.e.	n.e.
AO604a	27	n.e.	n.e.	0	24	21	¼	No	Leaf not available	-		Pink	4	2	Obtuse	A	A	x2	x4	Included or partially exerted	n.e.	n.e.	n.e.
AO604b	46	n.e.	n.e.	6	28	31	¼	No	Scabridulous by minute papillae on the terminal part of young leaves, sometimes in an irregular or patchy distribution	C	75	Pink	4	2	Obtuse	A	A	x2	x4	Included	n.e.	n.e.	n.e.
AO605a	25	n.e.	n.e.	5	13	11	¼	No	Smooth or subcrenulate with flattened, weathered papillae	B		Pink	3.5	2	Obtuse	A	A	x2	x4	Included or partially exerted	n.e.	n.e.	n.e.
AO605b	32	n.e.	n.e.	4	18	26	½–¾	No	Smooth or subcrenulate with flattened, weathered papillae	B		Pink	4	2	Subacute	A	A	x1.5	x4	Included or partially exerted	n.e.	n.e.	n.e.
AO607a	60	n.e.	n.e.	10	45	32	¼	No	Smooth, margin a narrow hyaline lining	A		Pink	5	2	Obtuse	A	A	x1.5	x4	Included or partially exerted	n.e.	n.e.	n.e.
AO607b	50	n.e.	n.e.	8	45	36	¼	No	Smooth or subcrenulate with flattened, weathered papillae	B		Very pale pink	4.5	2	Obtuse	A	A	x0.75	x1.5	Included or partially exerted	Helmet or subspherical (Type A)	n.e.	6.0
AO616a	68	n.e.	n.e.	12	43	37	¼	No	Smooth or subcrenulate with flattened, weathered papillae	B		Pink	4.5	2	Obtuse	A	A	x1.5	x4	Included or partially exerted	n.e.	n.e.	n.e.

AO617a	38	n.e.	n.e.	5	35	29	½ – ¾	No	Smooth, margin a narrow hyaline lining	A		Pink	4	2	Obtuse	A	A	x1.5	x4	Included or partially exerted	n.e.	n.e.	n.e.
AO617b	181	n.e.	n.e.	24	91	77	½-¾	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	E	n.e.	Light violet	4	2	Obtuse	A	A	n.e.	n.e.	Fully exerted	Helmet or subspherical (Type A)	n.e.	12.5
AO617c	163	n.e.	n.e.	18	70	75	¼-½	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	E	n.e.	Light violet	4	2	Obtuse	A	A	n.e.	n.e.	Fully exerted	n.e.	n.e.	n.e.
BS502a	35	Maroon	38	9	23	26	¼	No	Scabridulous by minute papillae on the terminal part of young leaves, sometimes in an irregular or patchy distribution	C	75–100	White (0)	4	2	Obtuse	A	A	x2.5	x3	Included or partially exerted	Helmet or subspherical (Type A)	6.0	7.0
BS502b	82	Maroon, turning green towards the	30	14	49	55	¼	No	Smooth or subcrenulate with flattened, weathered papillae	B		Lilac-white (1)	4.5	2	Obtuse (to almost truncate) with	A	A	x2.2	x2	Included or partially exerted	Helmet or subspherical (Type A)	10.0	11.0
BS502c	46	Maroon	n.e.	6	26	29	¼	No	Smooth, margin a narrow hyaline lining	A		Pale Purple (2)	4.5	2	Obtuse to almost truncate.	A	A	x2	x2	Included or partially exerted	n.e.	n.e.	n.e.
BS502d	42	Maroon	n.e.	12	30	35	¼	No	Scabridulous by minute papillae on the terminal part of young leaves, sometimes in an irregular or patchy distribution	C	75–100	Lilac-white (1)	5	2	Obtuse with a short blunt subcuspidate	A	A	x2.5	x3.2	Included or partially exerted	Helmet or subspherical (Type A)	7.0	8.0
BS502e	65	Maroon	n.e.	12	47	50	¼	No	Scabridulous by minute papillae on the terminal part of young leaves, sometimes in an irregular or patchy distribution	C	75	Lilac-white (1)	4.5	2	Obtuse with a short blunt subcuspidate	A	A	x2	x2	Included or partially exerted	Helmet or subspherical (Type A)	n.e.	n.e.
BS502f	28	Maroon	n.e.	10	20	20	¼	No	Scabridulous by minute papillae on the terminal part of young leaves, sometimes in an irregular or patchy distribution	C	50	Lilac-white (1)	4.5	2	Subacute	A	A	x2	x1.8	Included or partially exerted	n.e.	n.e.	n.e.
BS504a	65	Maroon	n.e.	10	25	35	½ – ¾	No	Smooth or subcrenulate with flattened, weathered papillae	B		Lilac-white (1)	4.5	2	Subacute to obtuse	A	A	x3	x2.5	Included or partially exerted	Helmet or subspherical (Type A)	8.5	10.0
BS504b	75	Maroon	n.e.	10.5	39	45	½ – ¾	No	Scabridulous by minute papillae on the terminal part of young leaves, sometimes in an irregular or patchy distribution	C	50–75	Lilac-white (1)	4.5	2	Subacute to obtuse	A	A	x2.5	x2.2	Included or partially exerted	n.e.	9.0	10.0
BS505a	50	Maroon	n.e.	8.5	25	34	½ – ¾	No	Smooth or subcrenulate with flattened, weathered papillae	B		Lilac-white (1)	4.5	2	Subacute	A	A	x2	x2.5	Included or partially exerted	Helmet or subspherical (Type A)	7.5	8.5
BS505b	35	Maroon	n.e.	7	22	28	½ – ¾	No	Smooth or subcrenulate with flattened, weathered papillae	B		Lilac-white (1)	4	2	Subacute	A	A	x1.8	x2	Included or partially exerted	Helmet or subspherical (Type A)	6.5	7.0
BS506a	105	Maroon	55	17	60	66	¼	No	Scabridulous by minute papillae on the terminal part of young leaves, sometimes in an irregular or patchy distribution	C	75–100	Lilac-white (1)	4.5	2	Obtuse ending with a small pointed	A	A	x2	x2.2	Included or partially exerted	Helmet or subspherical (Type A)	11.0	11.5
BS512a	32	Maroon	n.e.	5	20	24	¼	No	Smooth or subcrenulate with flattened, weathered papillae	B		Lilac (2)	4	2	Obtuse	A	A	x2	x3.5	Included or partially exerted	Helmet or subspherical (Type A)	4.5	5.0
BS512b	30	Maroon, turning green towards the	n.e.	5	15	24	¼	No	Smooth or subcrenulate with flattened, weathered papillae	B		Purple (3)	4.5	2	Acute	A	A	x2.5	x3.5	Included	Helmet or subspherical (Type A)	5.0	6.0
BS512c	27	Maroon	n.e.	5	16	25	¼	No	Smooth or subcrenulate with flattened, weathered papillae	B		Purple (3)	5	2	Acute	A	A	x2	x3	Included or partially exerted	Helmet or subspherical (Type A)	5.0	6.0
BS513a	67	Maroon, turning green towards the	n.e.	9	26	37	¼	No	Smooth or subcrenulate with flattened, weathered papillae	B		Lilac (2)	4.5	2	Acute	A	A	x2.5	x3	Included or partially exerted	Helmet or subspherical (Type A)	8.0	10.0
BS513b	30	Maroon	25	4	17	18	¼	No	Smooth or subcrenulate with flattened, weathered papillae	B		White (0)	4	2	Sub-acute	A	A	x2.5	x3	Included or partially exerted	Helmet or subspherical (Type A)	4.0	5.0
BS513c	28	Maroon	n.e.	6	27	28	¼	No	Smooth or subcrenulate with flattened, weathered papillae	B		Lilac-White (1)	4.5	2	Obtuse ending with a small pointed	A	A	x2	x2.2	Included or partially exerted	Helmet or subspherical (Type A)	10.0	11.0
BS514a	35	Maroon	n.e.	5	20	24	¼	No	Scabridulous by minute papillae on the terminal part of young leaves, sometimes in an irregular or patchy distribution	C	50–75	Lilac-White (1)	4	2	Obtuse ending with a small pointed	A	A	x2.2	x3	Included	Helmet or subspherical (Type A)	5.5	7.0
BS514b	70	Maroon	n.e.	13	52	58	¼	No	Smooth, margin a narrow hyaline lining	A		Pale purple-mauve (2)	5	2	Subacute	A	A	x2	x3	Included or partially exerted	Helmet or subspherical (Type A)	10.0	11.0
BS515a	25	Maroon	n.e.	3	19	20	¼	No	Scabridulous by minute papillae on the terminal part of young leaves, sometimes in an irregular or patchy distribution	C	50	White (0)	5	2	Subacute, some ending with a very	A	A	x2.5	x2.5	Included or partially exerted	Helmet or subspherical (Type A)	n.e.	n.e.
BS515b	72	Maroon	28	13	36	41	½ – ¾	No	Smooth, margin a narrow hyaline lining	A		Light purple (2)	4.5	2.2	Obtuse (to almost truncate)	A	A	x2.2	x2.2	Included or partially exerted	n.e.	n.e.	n.e.
BS515c	85	Maroon	25	16	46	47	¼	No	Smooth, margin a narrow hyaline lining	A		Lilac (1)	4.5	2	Obtuse to subacute	A	A	x2	x2.5	Included or partially exerted	n.e.	n.e.	n.e.
BS518a	100	Maroon	n.e.	14	63	60	½ – ¾	No	Smooth or subcrenulate with flattened, weathered papillae	B		Purple (3)	4.5	2	Obtuse	A	A	x3.0	x2.2	Included or partially exerted	Helmet or subspherical (Type A)	10.0	11.0
BS518b	80	Maroon	n.e.	10	41	45	¼	No	Smooth or subcrenulate with flattened, weathered papillae	B		Pale purple (2)	5	2	Obtuse with a short mucronate	A	A	x2.5	x2.5	Included or partially exerted	Helmet or subspherical (Type A)	8.0	9.0
BS520a	80	Maroon	n.e.	18	32	38	½ – ¾	No	Smooth or subcrenulate with flattened, weathered papillae	B		Pale purple (2)	4.5	2	Acute	A	A	x3.0	x2.5	Included or partially exerted	n.e.	n.e.	n.e.
BS520b	85	Maroon	45	12	42	42	½ – ¾	No	Scabridulous by minute papillae on the terminal part of young leaves, sometimes in an irregular or patchy distribution	C	75	Pale purple (2)	4	2	Subacute with a mucronate tip	A	A	x1.8	x2.2	Included or partially exerted	Helmet or subspherical (Type A)	9.0	10.0

BS520c	75	Maroon	n.e.	8	29	30	½ - ½	No	Smooth or subcrenulate with flattened, weathered papillae	B		Pale purple (2)	4	1.8	Subacute	A	A	x2	x2.5	Included or partially exerted	Helmet or subspherical (Type A)	6.5	7.0
BS520d	22	Maroon	50	3	16	18	¾	No	Scabridulous by minute papillae on the terminal part of young leaves, sometimes in an irregular or patchy distribution	C	50	Lilac-white (1)	4	2	Subacute	A	A	x1.8	x2.0	Included or partially exerted	Helmet or subspherical (Type A)	5.0	6.0
BS520e	55	Maroon	n.e.	6	19	19	¾	No	Scabridulous by minute papillae on the terminal part of young leaves, sometimes in an irregular or patchy distribution	C	50-75	Pale purple (2)	4	1.8	Acute	A	A	x3.5	x2.5	Included or partially exerted	Helmet or subspherical (Type A)	6.0	7.5
BS520f	82	Maroon	n.e.	10	36	42	¾	No	Scabridulous by minute papillae on the terminal part of young leaves, sometimes in an irregular or patchy distribution	C	50-75	Pale purple (2)	5	2	Obtuse with a mucronate tip	A	A	x3	x2.5	Included	Helmet or subspherical (Type A)	10.0	11.0
BS520g	16	Maroon, turning green towards the	n.e.	2	10	11	¾	No	Smooth, margin a narrow hyaline lining	A		Pale purple (2)	4	2	Subacute	A	A	x3	x2.5	Included	n.e.	n.e.	n.e.
BS523a	45	Maroon	45	8	31	36	¾	No	Smooth, margin a narrow hyaline lining	A		Purple (3)	4.5	2	Obtuse-truncate	A	A	x3	x2.2	Included or partially exerted	Helmet or subspherical (Type A)	10.0	11.5
BS527a	55	Maroon	n.e.	7	35	32	¾	No	Smooth or subcrenulate with flattened, weathered papillae	B		Pale purple (2)	4.5	2	Subacute	A	A	x2	x2.8	Included or partially exerted	Helmet or subspherical (Type A)	9.0	10.0
BS527b	27	Pale green becoming maroon at the	32	9	25	22	¾	No	Scabridulous by minute papillae on the terminal part of young leaves, sometimes in an irregular or patchy distribution	C	75	Lilac (1)	4	2	Obtuse to sub-truncate	A	A	x2	x3.0	Included or partially exerted	Helmet or subspherical (Type A)	6.0	7.0
BS528a	37	Maroon	32	6	28	31	¾	No	Smooth or subcrenulate with flattened, weathered papillae	B		Lilac (1)	4	2	Subacute	A	A	x2	x3.2	Included or partially exerted	n.e.	n.e.	n.e.
BS601a	17	Maroon	n.e.	4	18	15	¾	No	Scabridulous by minute papillae on the terminal part of young leaves, sometimes in an irregular or patchy distribution	C	50	Lilac (1)	4	2	Obtuse	A	A	x2	x3	Included or partially exerted	n.e.	n.e.	n.e.
BS601b	26	Maroon	30	6	25	28	¼ - ¼	No	Scabridulous by minute papillae on the terminal part of young leaves, sometimes in an irregular or patchy distribution	C	50	Pale purple (2)	4.5	2	Obtuse	A	A	x1.8	x2.5	Included or partially exerted	n.e.	n.e.	n.e.
BS601c	85	Maroon	30	15	50	52	¾	No	Scabridulous by minute papillae on the terminal part of young leaves, sometimes in an irregular or patchy distribution	C	50	Lilac (1)	4.5	2	Obtuse	A	A	x2	x3	Included or partially exerted	Helmet or subspherical (Type A)	n.e.	n.e.
BS601d	25	Maroon, green towards the apex	20	7	22	25	¾	No	Smooth	A		Lilac (1)	4	2	Obtuse with a short blunt tip	A	A	x2	x2.2	Included or partially exerted	Helmet or subspherical (Type A)	6.0	7.0
BS603a	75	n.e.	n.e.	45	55	62	¾	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	G	n.e.	Dark purple (4)	5.5	2.5	Acute to sub-acute	D	A	x1.5	x0.8 to x1.0 (lamina ≤ than cusp)	Fully exerted by >2mm	Hemispherical to helmet shape with short cuspidate ends.	18.0	20.0
BS603b	95	n.e.	n.e.	42	78	82	¾	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	n.e.	n.e.	Purple (3)	5.5	2.5	Subacute with a small blunt tip.	D	A	x1.5	x0.8 to x1.0 (lamina ≤ than cusp)	Fully exerted by >2mm	Hemispherical to helmet shape with short cuspidate ends.	22.0	25.0
BS603c	74	n.e.	n.e.	28	40	48	¾	Yes	Denticulate-hairy margin formed by flattened, finger-shaped papillae (300-350 long), with obtuse, non-swollen tips and slightly broad bases.	G	300-350	Purple (3)	5.5	2.8	Subacute	D	A	x1.5	x1 - x1.2	Fully exerted by >2mm	Hemispherical to helmet shape with short cuspidate ends.	17.0	19.0
BS603d	95	n.e.	n.e.	37	61	55	¾	Yes	Denticulate-hairy margin formed by flattened, finger-shaped papillae up to 350 long), with obtuse, non-swollen tips and slightly broad bases.	G	275-350	Purple (3)	5	2.5	Subacute	D	A	x1.8	x1 - x1.2	Fully exerted by >2mm	Hemispherical to helmet shape with short cuspidate ends.	21.0	24.0
BS606a	180	Membranous, pale green	42	31	68	77	¾	Yes	Scabrid margin composed of mixed types of papillae: short knobby papillae (75-100 long) and cylindrical to finger-shaped papillae (250). Distribution of papillae	F	75-250	Dark purple (4)	4	2	Obtuse	C	A	x2.2	x1.8	Fully exerted by 2-3mm	Mixed shapes (Type C)	14.0	17.0
BS606b	30	Maroon, green towards the apex	n.e.	5	24	26	¾	No	Scabrid margin composed of mixed types of papillae: short knobby papillae (75-100 long) and cylindrical to finger-shaped papillae (250). Distribution of papillae	F	75-250	White (0)	4.5	2	Subacute	A	A	x2.0	x3.0	Partially exerted (0.5-1.0mm)	Helmet or subspherical (Type A)	7.0	8.0
BS606c	80	n.e.	n.e.	12	41	47	½ - ½	Yes	Scabrid margin composed of mixed types of papillae: short knobby papillae (75-100 long) and cylindrical to finger-shaped papillae (250). Distribution of papillae	F	125-250	Dark purple (4)	4	2	Obtuse, sometimes with a tiny,	B-C	A + B	x2.2	x1.5	Fully exerted by 2-3mm	Mixed shapes (Type C)	12.0	13.0
BS606d	71	n.e.	n.e.	19	45	46	¾	Yes	Scabrid margin composed of mixed types of papillae: short knobby papillae (75-100 long) and cylindrical to finger-shaped papillae (250). Distribution of papillae	G	275-350	Pale purple (2)	4.5	2	Acute to Subacute	D	A	x3.0	x1.5	Fully exerted by >2mm	Hemispherical to helmet shape with short cuspidate ends.	11.0	12.0
BS606e	95	n.e.	n.e.	20	56	58	¾	Yes	Scabrid margin composed of mixed types of papillae: short knobby papillae (75-100 long) and cylindrical to finger-shaped papillae (250). Distribution of papillae	G	300-400	Pale purple (2)	5	2.5	Subacute	D	A	x3.0	x1 - x1.2	Fully exerted by >2mm	Hemispherical to helmet shape with short cuspidate ends.	13.0	15.0
BS606f	138	Membranous, pale green	n.e.	19	67	67	¾	Yes	Scabrid margin composed of mixed types of papillae: short knobby papillae (75-100 long) and cylindrical to finger-shaped papillae (250). Distribution of papillae	F	200-250	Dark purple (4)	4	2.5	Subacute	C	A	x2.5	x1.5	Fully exerted (> 2mm)	Mixed shapes (Type C)	13.0	14.0
BS606g	48	Maroon	n.e.	6	28	32	¾	No	Scabridulous by minute papillae on the terminal part of young leaves, sometimes in an irregular or patchy distribution	C	50	Lilac (1)	4.5	2.5	Obtuse	A	A	x2.0	x2.0	Partially exerted (0.5-1.0mm)	Helmet or subspherical (Type A)	8.0	10.0
BS609a	160	Membranous, pale green	n.e.	26	48	52	¾	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	E	200-250	Dark purple (4)	4.5	2	Variable, subacute to acute	B	C	x2.8	x1.2	Fully exerted (> 2mm)	Mixed shapes (Type C)	14.0	16.0
BS609b	142	Membranous, pale green	n.e.	29	45	48	¾	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	E	200-250	Dark purple (4)	5	2.5	Acute	B	C	x2.8	x1	Fully exerted (> 2mm)	Mixed shapes (Type C)	n.e.	n.e.
BS609c	118	Membranous, pale green	75	20	40	44	¾	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	E	200-250	Dark purple (4)	4.2	2.5	Obtuse	B	C	x3.2	x1.1	Fully exerted (> 2mm)	Mixed shapes (Type C)	13.0	15.0
BS612a	160	Membranous, pale green	45	24	85	90	¾	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	E	175-225	Dark purple (4)	4.2	2.5	Acute to subacute	B	C	x2.5	x1.2	Fully exerted (> 2mm)	Mixed shapes (Type C)	10.0	13.0
BS612b	110	Membranous, pale green	n.e.	33	60	65	¾	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	E	200-250	Dark purple (4)	4	2.2	Acute to subacute	B	C	x2.5	x1.1	Fully exerted (> 2mm)	Mixed shapes (Type C)	9.0	13.0

BS612c	145	Membranous, pale green	55	33	80	82	½	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	E	225–250	Dark purple (4)	4.5	2.2	Obtuse	B	C	x2.4	x1.16	Fully exerted (> 2mm)	Mixed shapes (Type C)	11.0	12.5
BS627a	80	Membranous, pale green	35	14	40	42	½ – ¾	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	D	175–225	Pale mauve-purple (2)	4.5	2.5	Obtuse	B	D	x2	x1.4	Fully exerted (> 2mm)	Flattened, ovoid planoconvex, distinctly acuminate. (Type B)	12.0	15.0
BS627b	75	Membranous, pale green	40	13	38	45	½	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	D	150–200	Pale mauve-purple (2)	5	2.5	Obtuse	B	D	x2	x1.2	Fully exerted (> 2mm)	Flattened, ovoid planoconvex, distinctly acuminate. (Type B)	12.0	14.0
BS627c	60	Membranous, pale green	18	12	32	34	½ – ¾	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	D	150–200	Purple (3)	4.5	2.5	Obtuse to subacute	B	D	x1.8	x1.1	Fully exerted (> 2mm)	Flattened, ovoid planoconvex, distinctly acuminate. (Type B)	10.0	12.0
BS627d	70	Membranous, pale green	50	13	42	40	½ – ¾	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	D	150–225	Pale mauve-purple (2)	4	2.5	Obtuse	B	D	x2.2	x1.1	Fully exerted (> 2mm)	Flattened, ovoid planoconvex, distinctly acuminate. (Type B)	14.0	18.0
BS627f	75	Membranous, pale green	45	15	45	45	½ – ¾	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	D	175–250	Pale mauve-purple (2)	4	2	Obtuse	B	D	x2	x1.2	Fully exerted (> 2mm)	Flattened, ovoid planoconvex, distinctly acuminate. (Type B)	11.0	14.0
BS628a	120	Membranous, pale green	35	24	72	82	½	Yes	Denticulate-scabrid with distinct papillae visible by the naked eye along entire margin	D	150–225	Pale Purple (2)	4.5	2.5	Obtuse	B	D	x2.2	x1.2	Fully exerted (> 2mm)	Flattened, ovoid planoconvex, distinctly acuminate. (Type B)	13.0	19.0
BS628b	75	Maroon	25	9	35	35	¼	No	Smooth or subcrenulate with flattened, weathered papillae	B	n.e.	n.e.	5	2	Acute to subacute (dried tepals)	A	A	n.e.	n.e.	n.e.	Helmet to subspherical (Type A)	9.0	9.0
BS628c	75	Maroon	n.e.	8	38	36	¼	No	Smooth or subcrenulate with flattened, weathered papillae	B	n.e.	n.e.	4.5	2	subacute with a tiny cuspidate tip	A	A	n.e.	n.e.	n.e.	Helmet to subspherical (Type A)	11.0	12.0
BS628d	120	n.e.	n.e.	18	55	58	½	Yes	Dispersed small papillae in different sizes, many worn out in lower leaves or proximal parts of upper leaves, 50-150µm long, hemispherical or teat-shaped.	n.e.	n.e.	n.e.	4.5	2	Subacute (dried tepals)	C-D	A	n.e.	n.e.	n.e.	Mixed shapes (Type C)	12.0	15.0
CO517a	35	Maroon	n.e.	9	24	21	¼	No	Smooth, margin a narrow hyaline lining	A	n.e.	Lilac (1)	4	2	Subacute	A	A	x 2	x 2.5	Partially exerted	n.e.	n/a	n/a
CO517b	42	Maroon	n.e.	6	31	40	¼	No	Smooth or subcrenulate with flattened, weathered papillae	B	n.e.	Lilac (1)	4	2	Subacute	A	A	x2	x2.5	Partially exerted	Helmet or subspherical (Type A)	8.0	8.0
CO517c	68	Maroon	n.e.	10	38	46	¼	No	Smooth, margin a narrow hyaline lining	A	n.e.	Lilac (1)	4	2	Subacute	A	A	x2	x2.5	Partially exerted	Helmet or subspherical (Type A)	7.0	7.5
CO524a	55	Maroon	n.e.	7	25	30	¼	No	Smooth, margin a narrow hyaline lining	A	n.e.	Lilac (1)	4.5	2	Subacute	A	A	x2	x2.5	Included	Helmet or subspherical (Type A)	9.5	10.0
CS625a	120	Membranous, pale green	160	30	43	50	½	Yes	Distinct compressed subspherical papillae throughout the entire margin, homogenous	D	125–150	White (0)	4.5	2.5	Obtuse	B	D	x3.3	x1.8	Fully exerted (> 2mm)	Flattened, ovoid planoconvex, long acuminate. (Type B)	20.0	34.0
CS625b	90	Membranous, pale green	120	33	46	55	½ – ¾	Yes	Distinct compressed subspherical papillae throughout the entire margin, widely spaced, homogenous	D	150	White (0)	4	2.5	Obtuse	B	D	x3	x2	Fully exerted (> 2mm)	Flattened, ovoid planoconvex, long acuminate. (Type B)	24.0	32.0
CS625c	100	Membranous, pale green	120	29	52	63	½	Yes	Distinct compressed subspherical papillae throughout the entire margin, homogenous	D	150–175	White (0)	4	2	Obtuse	B	D	x3.5	x1.6	Fully exerted (> 2mm)	Flattened, ovoid planoconvex, long acuminate. (Type B)	20.0	32.0
CS625d	110	Membranous, pale green	180	27	45	47	½ – ¾	Yes	Distinct compressed subspherical papillae throughout the entire margin, homogenous	D	100-125	White (0)	4.5	2.5	Subacute (blunt)	B	D	x3.2	x2	Fully exerted (> 2mm)	Flattened, ovoid planoconvex, long acuminate. (Type B)	25.0	40.0
CS625e	90	Membranous, pale green	100	28	45	55	¾ – ½	Yes	Distinct compressed subspherical papillae throughout the entire margin, widely spaced, homogenous	D	125–175	White (0)	4.5	2.5	Subacute (blunt)	B	D	x3.0	x1.9	Fully exerted (> 2mm)	Flattened, ovoid planoconvex, long acuminate. (Type B)	27.0	35.0
CS625f	60	Membranous, pale green	140	22	35	38	¼	Yes	Distinct compressed subspherical papillae throughout the entire margin, homogenous	D	150	White (0)	4.5	2	Obtuse	B	D	n.e.	n.e.	Fully exerted (> 2mm)	Flattened, ovoid planoconvex, long acuminate. (Type B)	19.0	26.0
CS625g	150	Membranous, pale green	160	38	70	60	¼	Yes	Distinct compressed subspherical papillae throughout the entire margin, homogenous	D	150	White (0)	5	3	Obtuse	B	D	n.e.	n.e.	Fully exerted (> 2mm)	Flattened, ovoid planoconvex, long acuminate. (Type B)	28.0	38.0