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ALLIACEAE

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Alliaceae Agardh, Theor. Syst. Pl. (1858) 32; Dahlgren, Clifford & Yeo, Fam. Monocot. (1985) 193–196. — *Liliaceae* subfam. *Allioideae*, Melchior in Melchior, Syll. Pflanzenfam. ed. 12 (1964) 521.

Perennial herbs with bulbs, bulb-like corms or rhizomes. *Leaves* simple, basally concentrated, spirally set or distichous. *Inflorescence* usually umbellate and with 1, 2 or more membranous spathes. *Flowers* generally bisexual, actinomorphic or sometimes zygomorphic. *Tepals* in 2 whorls, free or often connate, forming a campanulate or tubular perianth with erect, spreading or sometimes recurved lobes. *Stamens* usually 6 or sometimes 5 with several staminodes, free, inserted at the base of the tepals or in the perigone-tube; anthers dorsifixed. *Ovary* superior, 3-celled, with axillary placentas, septal nectary grooves present on the ovary; ovules 2 to several per locule. *Fruit* a loculicidal capsule. *Seeds* often half-ovoid, half-globose or tetrahedral and triangular in transection, sometimes ovoid or ellipsoid to subglobose and rounded in transection.

Distribution — As circumscribed by Dahlgren et al. (1985) this segregate from *Liliaceae* s.l. comprises the South African *Agapanthoideae*, the mainly Chilean *Gilliesioideae*, and *Allioideae* with the neogeic tribe *Brodiaeeae* and the nearly cosmopolitan *Allieae*.

Taxonomy — The taxonomic position of the genus *Allium* and related genera is still disputed. Earlier botanists (e.g., Engler, Bentham, and Hooker) placed them in the *Liliaceae*, as recently followed again by, e.g., Cronquist (1981) and Mabberley (1987). Alternatively, they were included in the *Amaryllidaceae* by, e.g., Hutchinson and Traub (see Hanelt 1990). Often also *Allium* and its close relatives are recognized as a distinct family *Alliaceae*, close to the *Amaryllidaceae* (Dahlgren et al. 1985). This controversy does not matter much for Malesia since only *Allium* and *Nothoscordum* are found there, both not indigenous.

References: Cronquist, A., Integrated system of classification of Flowering Plants (1981) 1208. — Dahlgren, R.M.T., H.T. Clifford & P.F. Yeo, The families of the Monocotyledons (1985) 193. — Hanelt, P., in H.D. Rabinowitch & J.L. Brewster (eds.), Onions and allied crops, Vol. 1 (1990) 2. — Mabberley, D.J., The Plant-Book (1987) 331.

Palynology — The approximately 34 genera that make up the *Alliaceae* (see Dahlgren & Clifford 1982) are palynologically rather poorly known. Pollen of representatives of 20 genera has been described (Tissot 1990), but nearly always with light microscopy only. The most comprehensive works include Heusser (1971) and Schulze (1980). Beug (1961),

[1] The International Board for Plant Genetic Resources IBPGR financed a taxonomic survey of *Allium* species cultivated in SE Asia, that included a collection trip to Java in 1989.

Radulescu (1973), Kuprianova & Aliev (1979) and Pastor (1981) give more or less extensive accounts on *Allium* pollen. Pollen of *Nothoscordum*, the other genus found in Malesia, is dealt with by Schulze (l.c.).

Pollen grain size (length of largest equatorial axis) in *Alliaceae* is usually 25–55 µm. Several genera have significantly larger pollen: *Agapanthus* (up to 75 µm), *Brodiaea* (up to 78 µm), *Dichelostemma* (up to 70 µm), *Milla* (69–115 µm) and *Triteleia* (up to 72 µm). The aperture system is always monosulcate. The sulcus is nearly as long as the long equatorial axis and restricted to the distal grain side, or it may continue on both ends on the proximal side. Exine thickness is usually 1–2 µm, rarely < 1 µm or 2–3 µm. The exine is columellate, and tectate or semitectate. The sexine is always thicker than the nexine. Ornamentation varies from psilate with (very) small perforations to reticulate. The diameter of the perforations/lumina is mostly 0.5–1.5 µm. Reticulate ornamentation with larger lumina is found in pollen of *Dichelostemma* (1.5–4 µm), *Milla* (3–7 µm) and *Muilla* (1.5–4 µm). Reticulate ornamentation is usually heterobrochate, i.e. with lumina of different sizes mingled on the proximal grain side. Towards the sulcus lumen size more or less gradually decreases. Finely striate-rugulate ornamentation with minute perforations was found in *Allium* using scanning electron microscopy (Pastor 1981).

The *Alliaceae* is a stenopalynous family. Palynologically the subfamilies are not distinct from each other. In the *Allioideae* two groups might be distinguished (Schulze l.c.). On infrageneric level the length of the sulcus may sometimes be of taxonomic significance, for example in *Allium* (Kuprianova & Aliev l.c.; Pastor l.c.). Pollen like that of the *Alliaceae* occurs in many other monocot families.

References: Beug, H.-J., Leitfaden der Pollenbestimmung (1961). — Dahlgren, R.M.T. & H.T. Clifford, The monocotyledons: a comparative study (1982). — Heusser, C.J., Pollen and spores of Chile (1971). — Kuprianova, L.A. & T.A. Aliev, Bot. Zhurn. 64 (1979) 1273–1284. — Pastor, J., Bot. Macaronesica 8/9 (1981) 189–214. — Radulescu, D., Acta Bot. Hort. Bucur. 1972–73 (1973) 133–248. — Schulze, W., Wiss. Z. Friedr.-Schiller-Univ. Jena, Math.-Naturwiss. R. 29 (1980) 595–606. — Tissot, C., Sixth bibliographic index to the pollen morphology of Angiosperms (1990).

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Phytochemistry (compare also the relevant chapter under *Amaryllidaceae*) — All members of *Allium* emit after wounding characteristic odours known as 'onion odour' and 'garlic odour'. Everywhere mankind met species of *Allium*, it made use of their spicy, culinary and medicinal properties. *Allium* taxa, including a lot of cultivars of the onion group (*A. cepa*), the garlic group (*A. sativum*) and the leek group (*A. porrum*), are cultivated from time immemorial in southern Europe and the Near East. *Allium kurrat* seems to have been taken in cultivation in ancient Arabia, Palestina and Egypt and *A. chinense, fistulosum, macrostemon* and *tuberosum* had or still have many ancient cultivars from India to China and Japan. Chives (*A. schoenoprasum*) were taken in cultivation in postroman time in Europe.

There are three classes of secondary metabolites which apparently are produced by all species of *Allium*. Firstly a range of sulphur compounds which originate all after wounding from genuine S-alkyl- and S-alkenylcysteines and are responsible for the characteristic odour. Secondly complex mixtures of biologically active saponins with C_{27} steroidal sapogenins. Thirdly phenolic compounds which seem to be mainly derivatives of the flavonols kaempferol and quercetin and simple phenolic acids such as protocatechuic and ferulic acid. Perhaps biogenic amines and simple amides and alkaloids represent another group of characteristic *Allium* metabolites.

The totality of the presently known chemical compounds indicates that *Allium*, and possibly *Allioideae*, have one taxon-characteristic chemical character, namely production of S-alkylated cysteines. By their saponins *Allioideae* are reminiscent of that part of *Liliiflorae* which is classified by Dahlgren et al. (1985) in *Dioscoreales* and *Asparagales*. Biochemically *Allioideae* are clearly distinct from *Amaryllidaceae* s. str., *Haemodoraceae*, *Hypoxidaceae* and all the families reunited in *Liliales* sensu Dahlgren et al. (1985).

Phytochemistry and chemotaxonomy of *Alliaceae* were discussed twice by Hegnauer (1963, 1986) sub *Liliaceae*; in these treatises many references can be found. Some results of recent phytochemical investigations will shortly be mentioned in the following alineas.

Sulphur compounds are usually considered to be mainly responsible for the medicinal virtues of garlic and other species of *Allium*. This initiated a large number of chemical, analytical and medicinal publications; see e.g. Ziegler et al. (1989), Sticher (1991), Block (1992), Hikino et al. (1986) and others. The S-alkylated cysteines are stored in fresh bulbs, leaves and seeds of *Allium* species as γ-glutamyl peptides. During long storage or on wounding a lot of mostly enzymatic transformations can take place, e.g.: generation of the free S-alkylated cysteines; oxidation to S-alkylated cysteine sulfoxides (the S-allyl-derivative is alliin); transformation of the sulfoxides to dialkyl thiosulfinates (the diallyl-derivative is allicin); this last step is catalysed by the enzyme alliinase which is only known from the genera *Allium* and *Nothoscordum*. S-*trans*-1-propenylcysteine (the precursor of the lachrimatory factor of onion), S-allyl-cysteine (the precursor of alliin and allicin), S-methylcysteine and S-propylcysteine occur in variable amounts and proportions in different species of *Allium* (Lawson et al. 1991). New transformation products of allicin are the ajoenes and the vinyldithiins of *A. sativum* (Sticher 1991). Onions produce on grating and slicing variable amounts of thiopropanal-S-oxide (lachrimatory factor), 2-methyl-2-pentenal, propanethiol, dipropyldisulfide, propenyl-propyldisulfide and others (Tokitomo & Kobayashi 1992). The cepaenes and deoxycepaenes of *A. cepa* are isomers of the *A. sativum* ajoenes (Block & Zhao 1992). Other types of sulphur compounds were isolated from subterranean parts of *Tulbaghia violacea* (Burton et al. 1992).

All species of *Allium* produce monodesmosidic spirostanol-type and bidesmosidic furostanol-type steroidal saponins. A review treating 26 species, 26 sapogenins and 40 saponins was published by Kravets et al. (1990). Of the sapogenins mentioned agiogenin, alliogenin, the ansurogenins, cepagenin, gantogenin, the karatavigenins, luvigenin, neoagigenin and its 6-benzoate and neoalligenin are new C_{27}-spirostanols. Agiogenin was first isolated from *A. giganteum* (therefore not aiogenin: Dahlgren et al. 1985: 195). New saponins were isolated among others from bulbs of *A. ampeloprasum* (Morita et al. 1988), bulbs of *A. chinense* (Matsuura et al. 1989a), bulbs of *A. giganteum* (Sashida et al. 1991), flowers of *A. porrum* (Harmatha et al. 1987), bulbs and roots, but not leaves, of *A. sativum* (Matsuura et al. 1988, 1989b) and bulbs of *A. vineale* (Chen & Snyder 1987, 1989). The *vineale* saponins have molluscicidal activity; the leek saponin aginoside is concentrated in flowers and makes them unpalatable and toxic for larvae of the leek moth; the spirostanolsaponins aginosideprosapogenin and ampeloside-Bs_1 of *A. ampeloprasum* are fungitoxic whereas the bidesmosidic furostanol saponins ampeloside-Bf_1 and -Bf_2 did not inhibit the two species of Fungi tested; the same biological properties were observed in *A. sativum* with the fungitoxic eruboside-B, a spirostanolic β-chlorogenin-3-glycoside, and the inactive bidesmosidic furostanols proto-eruboside-B, sativoside-B1 and sativoside-R1. Bulbs of *Tristagma uniflora* yielded saponins with tigogenin, neotigogenin, two 25-epimeric 5α,6-dihydronuatigenins and two 25-epimeric 5α,6-dihydroisonuatigenins as aglycones (Brunengo et al. 1985). According to Koch (1992) the steroidal sapogenins may be involved in some of the therapeutical effects of onion and garlic.

Commercially available fresh leaves of *A. tuberosum* yielded three new kaempferol bis- and tris-glycosides with one of the sugar hydroxyls acylated by ferulic acid, a kaempferol and a quercetin 3,4'-bisglucoside and kaempferol-3-sophoroside (Yoshida et al. 1987).

Bulbs of *A. chinense* (= *A. bakeri*) yielded diallyl disulfide, the dihydrostilbene lunularic acid and the amides N-*p*-coumaroyltyramine and N-feruloyltyramine (Okuyama et al. 1986; Goda et al. 1987). Another amide, aurantiamide acetate, was isolated from whole plants of *A. wallichii* (Talapatra et al. 1989); these authors also reported isolation of the furanocoumarin imperatorin from the same plant without giving yields nor mentioning vouchers. A simple alkaloid related to N-methyltyramine and called alline (do not confound with alliin) was isolated from *A. ramosum* (= *A. odorum*) (Tashkhodzhaev et al. 1985) and sequently demonstrated to occur also in *A. altaicum, anisopodium, senescens, splendens, stellerianum* and *victorialis,* but not in *A. leucocephalum* and *A. schoenoprasum* var. *sibiricum* (Antsupova & Polozhiy 1987).

Bulbs of all investigated *Allium* species store fructans (Hegnauer 1963; Deinko 1985) and seeds store fatty oils with much linoleic acid (Hegnauer 1963; see for unsaturated fatty acids of *Allium* taxa also Deinko 1985). According to Afzal et al. (1985) lipids of bulbs of *A. sativum* contain much polyunsaturated fatty acids, such as linoleic, arachidonic (= eicosa-all-*cis*-5,8,11,14-tetraenoic) and an eicosapentaenoic acid.

Phytoalexins were induced in bulb scales of *A. cepa* by *Botrytis cinerea,* and subsequently two fungistatic compounds could be isolated; they were called tsibulin-1,$C_{11}H_{18}O_2$, and -2,$C_{13}H_{22}O_2$, after the Ukrainian name 'tsibulya' for onion; the tsibulins are 1-alkylcyclopentan-2,4-diones (Tverskoy et al. 1991).

Van Damme et al. (1991) prepared lectins from bulbs of five species of *Allium* and compared them with lectins of bulbs of six species of *Amaryllidaceae* s. str.; the taxonomic meaning of these results is not yet clear.

References: Afzal, M., et al., Agric. Biol. Chem. 49 (1985) 1187. — Antsupova, T.P. & A.V. Polozhiy, Rast. Resur. 23 (1987) 436. — Block, E., Organosulphur chemistry of Allium, Angew. Chemie, Intern. Ed. 31 (1992) 1135. — Block, E. & S.-H. Zhao, J. Org. Chem. 57 (1992) 5815. — Brunengo, M.C., et al., Phytochemistry 24 (1985) 1388. — Burton, S.G., et al., Planta Medica 58 (1992) 295. — Chen Shaoxing & J.K. Snyder, Tetrahedron Letters 28 (1987) 5603; J. Org. Chem. 54 (1989) 3679. — Dahlgren, R.M.T., H.T. Clifford & P.F. Yeo, The families of the Monocotyledons (1985). — Deinko, G.I., Rast. Resur. 21 (1985) 221 (lipids, fatty acids, carbohydrates). — Goda, Y., et al., Chem. Pharm. Bull. 35 (1987) 2668. — Harmatha, J., et al., Biochem. Syst. Ecol. 15 (1987) 113. — Hegnauer, R., Chemotaxonomie der Pflanzen 2 (1963) 281, 315–325, 488–489, 501; ibid. 7 (1986) 685–731, 803. — Hikino, H., et al., Planta Medica 52 (1986) 163 (antihepatotoxic action of garlic). — Koch, H.P., Zeitschr. Phytotherapie 13 (1992) 177 (ethnopharmacology of onion and garlic; modern pharmacological and clinical studies). — Kravets, S.D., et al., Khim. Prirod. Soedin. (1990) 429. — Lawson, D.A., et al., J. Nat. Prod. 54 (1991) 436. — Matsuura, H., et al., Chem. Pharm. Bull. 36 (1988) 3659; ibid. 37 (1989a) 1390 (chinensoside-I); ibid. 37 (1989b) 2741. — Morita, T., et al., Chem. Pharm. Bull. 36 (1988) 3480. — Okuyama, T., et al., Planta Medica 52 (1986) 171. — Sashida, Y., et al., Chem. Pharm. Bull. 39 (1991) 698 (new alliogenin derivatives). — Sticher, O., Deutsch. Apoth. Z. 131 (1991) 403 (active principles of garlic and their analytical control). — Talapatra, S.K., et al., Indian J. Chem. 28B (1989) 356. — Tashkhodzhaev, B., et al., Khim. Prirod. Soedin. (1985) 687. — Tokitomo, Y. & A. Kobayashi, Biosci. Biotechn. Biochem. 56 (1992) 1865. — Tverskoy, L., et al., Phytochemistry 30 (1991) 799. — Van Damme, E.J.M., et al., Phytochemistry 30 (1991) 509. — Yoshida, T., et al., Chem. Pharm. Bull. 35 (1987) 97. — Ziegler, S.J., et al., Deutsch. Apoth. Z. 129 (1989) 318 (analytical control of garlic preparations).

R. Hegnauer

KEY TO THE GENERA IN MALESIA

1a. Bruised leaves strongly smelling. Ovules 2 per locule (in the Malesian species); tepals free or basally shortly connate .... **Allium** *(p. 379)*

b. Bruised leaves not or hardly smelling. Ovules many per locule; tepals basally shortly connate .... **Nothoscordum** *(p. 384)*

ALLIUM

Allium L., Sp. Pl. 1 (1753) 294. — Type species: *Allium sativum* L.

Herbs, usually with onion-smell, bulbs often present, sometimes with short rhizomes, growing gregarious or not. *Leaves* linear to elliptic, sheathing the scape, the blades subapproximate or scattered along the scape, flat, or terete, semiterete, or angular and hollow. Scape terete or angular. *Inflorescence* umbellate, usually many-flowered, sometimes with bulbils, hemispherical to spherical or ± ellipsoid, enveloped by 1 or 2 green or scarious, persistent or caducous spathe(s). *Flowers* relatively small, white to pinkish or purplish, bluish, or yellowish, stellate to campanulate or urceolate. *Tepals* 6, (sub)equal in length, elliptic to lanceolate, free or usually shortly connate at base, persistent. *Stamens* 6; filaments simple or tricuspidate. *Ovary* with 2–14 ovules per locule; style slender, erect; stigma usually inconspicuous, single or 3-lobed. *Fruit* capsular, loculicidally 3-valved. *Seeds* 1–4 per locule, flattened, irregularly angled, blackish.

Distribution — Indigenous to the Northern Hemisphere, with at present about 500–700 species. In Malesia some taxa are cultivated, all are introduced, either from China, Central Asia, or Europe. They are all well-known *Allium* crops, grown worldwide.

Uses — Of *Allium* plants the bulbs, cloves, pseudo-stems, leaves, and young inflorescences are used as vegetable and condiment. *Allium* species are also widely used in different medicines for treating various diseases, e.g., diarrhoea, eye-infections, and headaches. Nowadays lowering of the blood pressure and inhibition of blood plate aggregation are considered the most important medical effects of *Allium* consumption. Many *Allium* species are grown as ornamentals; however, not so in Malesia because *Allium* species usually do not flower under tropical conditions. For a more elaborate treatment of the cultivated *Allium* species in SE Asia see Siemonsma & Kasem Piluek (eds.), Pl. Res. SE

Asia (PROSEA Handb. 8, Vegetables) (1993). See also: Backer & Bakh. f., Fl. Java 3 (1968) 130–132; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 98–103; Herklots, Veget. SE Asia (1972) 387–401; Heyne, Nutt. Pl. Ned.-Indië, ed. 2 (1927) 439–442; Jones & Mann, Onions and their allies. Botany, Cultivation, and Utilization (1963); Ochse & Bakh., Veget. Dutch East Indies (1931) 440–457; Purseglove, Trop. Crops Monocot. (1972) 37–57; Rabinowitch & Brewster (eds.), Onions and allied crops, Vol. 1 (1990).

KEY TO THE SPECIES CULTIVATED IN MALESIA

Where possible, vegetative characters are used, but sometimes additional generative characters are given. Often young plants with immature bulbs are sold as vegetable. In that case characters of the bulb are not fully reliable and other characters, e.g. leaves, should be checked.

1a. Leaves terete or semiterete, or 3–5-angled, hollow 2
b. Leaves flat, sometimes V-shaped or keeled, not hollow 6
2a. Leaves terete or semiterete, with a wide central cavity, easily compressible, usually diameter more than 5 mm (except *A. schoenoprasum* with a diameter of 1–5(–7) mm) 3
b. Leaves 3- or 5-angled, with a narrow central cavity, diameter 1–5 mm **3. A. chinense**
3a. Leaves terete, sometimes a few semiterete (check several leaves); mature bulbs distinct or indistinct, (narrowly) oblong to (narrowly) ovoid to elliptic 4
b. Leaves semiterete, flattened on upper surface (check several leaves); mature bulbs distinct, depressed globose to ovoid or obovoid (immature bulbs of multiplier shallot are narrowly oblong to narrowly ovoid). Variable! .... **2. A. cepa**
4a. Bulbs indistinct, diameter of bulb and neck equal or diameter bulb up to 1.5 times larger than diameter of neck 5
b. Bulbs distinct, diameter bulb 1.5–2 times larger than diameter neck **A. × proliferum** Wakegi Group (see note under *4. A. fistulosum*)
5a. Coarse plants; leaves fistulose, swollen in the centre, gradually tapering towards both ends, usually diameter more than 5 mm; flowers pale yellow; stamens exceeding the tepals .... **4. A. fistulosum**
b. Plants of finer habit; leaves fistulose, not swollen, usually diameter less than 5 mm; flowers usually purple, rarely white; stamens shorter than tepals **6. A. schoenoprasum**
6a. Bulbs not set on a rhizome; leaves 20–60 cm by 10–35 mm 7
b. Bulbs with several closely together on a rhizome; leaves 13–45 cm by 2–10 mm **7. A. tuberosum**
7a. Mature bulbs indistinct, ovoid to oblong, not composed of increase bulbs, increase bulbs (if present) much smaller than main bulb .... **1. A. ampeloprasum**
b. Mature bulbs distinct, depressed globose to ovoid, composed of cloves (increase bulbs), cloves as long as main bulb (immature plants of *A. sativum* resemble *A. ampeloprasum* but can be distinguished by the presence of cloves within the inner bulb-coat-leaves and by a typical garlic-smell) .... **5. A. sativum**

1. Allium ampeloprasum L., Sp. Pl. 1 (1753) 294.

Allium porrum L., Sp. Pl. 1 (1753) 295.

Bulb indistinct, ovoid to oblong, diameter up to c. 5 cm, gradually passing into the pseudo-stem. Increase bulbs absent, few, or many, situated within the outer bulbcoat-leaves. *Foliage leaves* 5–14, suberect, upper part curved, flat, V-shaped in cross section, up to 60 by 1–3.5 cm; sheaths extending much above the ground, forming a pseudo-stem. *Inflorescence* (hemi)spherical. *Flowers* usually campanulate, sometimes urceolate; tepals white to purple; stamens slightly shorter to longer than tepals.

Distribution – *Allium ampeloprasum* ranges as a wild plant from S Europe and N Africa through the Middle East into W and S Russia. A cultivated form, also known as *A. porrum*, is grown mainly in N Europe.

Common name – Leek (*A. porrum*).

2. Allium cepa L., Sp. Pl. 1 (1753) 300.

Bulb distinct, depressed globose to ovoid or obovoid, diameter 1–10(–15) cm. Increase bulbs absent to several, ± ovoid or of similar shape as the main bulb, often flattened on inner side. Protective bulbcoat-leaves several, papery, smooth, purplish, yellowish, brownish or white; storage leaves few to many. *Foliage leaves* 3–8(–9), erect to suberect, semiterete, fistulose, 10–50 cm by 3–20 mm. *Inflorescence* spherical. *Flowers* subcampanulate to urceolate; tepals greenish to whitish; stamens not or slightly exceeding tepals.

Two more or less distinct cultivar groups are distinguished:

1a. Bulbs small, diameter 1–3.5 cm; increase bulbs several; protective bulbcoat-leaves purplish, brownish, or white; plants 0.2–0.5 m, not robust . . . **a.** Cultivar group **Aggregatum**

b. Bulbs usually larger, diameter 2–10(–15) cm; increase bulbs absent or only few; protective bulbcoat-leaves light yellow to light brown or brown-purplish; plants 0.6–1.2 m, robust **b.** Cultivar group **Common Onion**

a. Cultivar group **Aggregatum**

Allium ascalonicum auct. non L.: Ochse & Bakh., Veget. Dutch East Indies (1931) 441.

Allium cepa L. var. *ascalonicum* Backer, Handb. Fl. Java 3 (1924) 60.

Bulb globose to ovoid, 1.5–4 by 1–3.5 cm. Increase bulbs several, of similar shape as the main bulb. Protective bulbcoat-leaves purplish, brownish, or white. *Foliage leaves* 10–35(–41) cm by 3–10 mm.

Distribution – Centre of origin in N Africa and E Mediterranean. Primary centre of diversity in the Near East. Shallots are grown in the USA, Europe, Africa, the Caribbean countries, Australia, and Asia.

Common names – Shallot, Multiplier shallot.

b. Cultivar group **Common Onion**

Allium cepa L. var. *typicum* Backer, Handb. Fl. Java 3 (1924) 60.

Bulb depressed globose to ovoid or obovoid, 3–5.5 by 2–10(–15) cm. Increase bulbs usually absent or, in cultivars from India and Burma, few present, ± ovoid. Protective bulbcoat-leaves light yellow to light brown or brown-purplish. *Foliage leaves* 35–50 cm by 10–20 mm.

Distribution – The onion is not known as a wild species, but in its primary centre of diversity, Central Asia, several related wild species occur. A secondary centre of diversity is the Near East and the Mediterranean, a rich diversity is also found in India.

Common names – Onion, Dry bulb onion.

3. Allium chinense G. Don, Mem. Wern. Nat. Hist. Soc. 6 (1827) 83; Mann & Stearn, Econ. Bot. 14 (1960) 69.

Allium exsertum (Lindley) Baker, J. Bot. (London) 12 (1874) 294, non G. Don (1827).

Allium bakeri Regel, Acta Horti Petrop. 3, iii (1875) 341.

Allium schoenoprasum auct. non L.: Heyne, Nutt. Pl. Ned. Indië ed. 2 (1927) 441; Ochse & Bakh., Veget. Dutch East Indies (1931) 455; Backer & Bakh. f., Fl. Java 3 (1968) 130.

Bulbs gregarious, narrowly ovoid, up to 3.5 cm long, diameter 7–15 mm, gradually passing into the leaves. Protective bulbcoat-leaves several, membranous, smooth, white, brownish or purplish. *Foliage leaves* 3–4(–5), prostrate to suberect, 3- or 5-angled in section, 20–40 cm by 1–5 mm. *Inflorescence* umbellate. *Flowers* campanulate; tepals light violet; stamens longly exceeding tepals.

Distribution – Native to C and E China. Cultivated in China, Japan, California, and SE Asia. Carried worldwide as a garden crop by Asian communities.

Note – Vegetative plants of *A. chinense* superficially resemble those of *A. schoenoprasum*. However, the latter species has terete leaves and indistinct bulbs, whereas *A. chinense* has more or less angled leaves and distinct bulbs.

Common name – Rakkyo.

Fig. 1. *Allium fistulosum* L. a. Habit; b, c. outer and inner tepal with corresponding filaments. From: B.E.E. de Wilde-Duyfjes, A revision of the genus Allium in Africa [Meded. Landbouwhogeschool Wageningen 76-11 (1976) 88, fig. 15].

4. Allium fistulosum L., Sp. Pl. 1 (1753) 301.

Bulb indistinct, oblong to ovoid, 3.5–8 cm long, width 5–25 mm, gradually passing into the leaves. Increase bulbs few to several, narrow and inconspicuous. Protective bulbcoat-leaves several, papery, smooth, brownish, whitish, or purplish. *Foliage leaves* 4–6, erect, terete, fistulose, 20–54 cm by 5–20 mm. *Inflorescence* (hemi)spherical. *Flowers* narrowly campanulate to urceolate; tepals pale yellow; stamens longly exceeding tepals. – **Fig. 1.**

Distribution – Origin in Siberia and China, not known as a wild species. *Allium fistulosum* has been, since prehistoric times, the main garden onion of China and Japan. It is cultivated widely throughout the world, ranging from Siberia to tropical Asia, including China, Japan, Korea, Taiwan, and the SE Asian countries.

Common names – Japanese bunching onion, Welsh onion, Green bunching onion.

Note – *Allium* × *proliferum* (Moench) Schrad. ex Willd. *Wakegi group*, a hybrid between *A. fistulosum* and *A. cepa* cv. group *Aggregatum*, is cultivated occasionally in Malesia. It has been grown for centuries in China, Japan, and SE Asia [Hanelt in Rabinowitch & Brewster (eds.), Onions and allied crops 1 (1990) 18]. This hybrid has characters from both parents. It develops a distinct bulb like the shallot, and terete leaves like *A. fistulosum* but slender and very erect. The flowers are subcampanulate as in *A. cepa*, but the stamens exceed the perianth and the inner filaments are without lateral teeth at the base as in the other parent. The hybrid is completely sterile and does not form fertile seeds.

5. Allium sativum L., Sp. Pl. 1 (1753) 297.

Bulb distinct, depressed globose to ovoid, diameter up to c. 7 cm, mainly composed of increase bulbs (cloves). Increase bulbs (1–)4–15, broadly ovoid to ovoid, as long as the main bulb when mature, wrapped in one cartilaginous prophyll. Protective bulbcoat-leaves papery or chartaceous, smooth, whitish or purplish, in young plants fibrous and brown. *Foliage leaves* 4–10, curved, flat, V-shaped in section, 20–50 cm by 10–25 mm. *Inflorescence* subspherical, composed either of only sessile bulbils (topsets) or of bulbils mixed with flowers. *Flowers* usually ill-developed, or rudimentary, or absent; perianth subcampanulate; tepals pale pink or greenish; stamens shorter than tepals.

Distribution – Some consider *A. longicuspis* Regel, endemic to Central Asia, as the wild parent of this cultigen. It was originally grown in Europe and China and nowadays worldwide.

Common name – Garlic.

6. Allium schoenoprasum L., Sp. Pl. 1 (1753) 301.

Bulbs gregarious, indistinct, oblong to narrowly ovoid, 1–3 cm long, gradually passing into scape and leaves, several set on a rhizome. Increase bulbs few to several, narrow and inconspicuous. Protective bulbcoat-leaves several, papery, smooth, brownish. *Foliage leaves* 3–6, erect, terete, fistulose, 10–50 cm by 1–5(–7) mm. *Inflorescence* (hemi)spherical. *Flowers* narrowly urceolate; tepals white to purple; stamens much shorter than tepals.

Distribution – This very variable species is known as a wild plant throughout the Northern Hemisphere: Europe, Asia, and North America. It is cultivated worldwide, in *Malesia* it is grown only occasionally.

Common name – Chive.

Note – *Allium schoenoprasum* is sometimes confused with *A. chinense*, see under the latter species.

7. Allium tuberosum Rottler ex Spreng., Caroli Linnaei Syst. Veg. 2 (1825) 38; Stearn, Herbertia 11 (1944) 226.

Allium uliginosum G. Don, Mem. Wern. Nat. Hist. Soc. 6 (1827) 60.

Allium odorum auct. non L.: Heyne, Nutt. Pl. Ned. Indië ed. 2 (1927) 441; Ochse & Bakh., Veget. Dutch East Indies (1931) 450; Backer & Bakh. f., Fl. Java 3 (1968) 131.

Allium bakeri auct. non Regel: Backer & Bakh. f., Fl. Java 3 (1968) 131.

Bulb indistinct, narrowly ovoid to ovoid, 15–20 by c. 15 mm, several set on a rhizome. Protective bulbcoat-leaves several, broken up into netted fibres, light brown to brown. *Foliage leaves* 4–9, suberect or curved, flat, slightly rounded or keeled on lower surface, 13–45 cm by 2–10 mm. *Inflorescence* umbellate. *Flowers* stellate; tepals white; stamens ± equalling tepals.

Distribution – The primary centre of origin is unknown, as this species easily runs wild. Known as a wild species in eastern Asia. Cultivation from E Mongolia to Japan, the Philippines, Indonesia, Malaysia and through Thailand to N India.

Common name – Chinese chive.

Note – Sometimes sub-naturalized.

NOTHOSCORDUM

Nothoscordum Kunth, Enum. Pl. 4 (1843) 457, nom. gen. cons.

Nothoscordum inodorum (Aiton) G. Nichols, Ill. Dict. Gard. 2 (1885/89) 457; Backer & Bakh. f., Fl. Java 3 (1968) 132; Jessop in Fl. Males. I, 9^1 (1979) 234.

Glabrous, inodorous herb with bulbs. *Leaves* radical, linear, flat, 15–45 cm by 5–12 mm. *Umbels* on up to 70 cm long peduncle, 6–17-flowered. *Tepals* 6, shortly connate at base, white, sometimes with a purple median streak. *Stamens* 6, inserted on the base of the perianth; filaments ligulate. *Ovary* with many ovules per locule. *Fruit* a capsule, loculicidally 3-valved. Seeds several, black.

Distribution – Native to subtropical North America; cultivated as an ornamental, often escaped and naturalized. In Java sometimes cultivated, locally naturalized in W Java (Backer & Bakh. f., l.c.).

Habitat & Ecology – Sometimes gregarious in fields, tea-gardens, and along roadsides, altitude 1000–1500 m. Fl.: Jan.–Dec. Easily propagated by bulbils and seeds, difficult to eradicate.

Note – The species was mentioned by Jessop (l.c.) in the Flora Malesiana treatment of *Liliaceae*, in which treatment the cultivated vegetables and condiments were ignored.