NOTES ON BUDDLEIA II: POLLEN

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In a quest for speedily discernible and easily recognisable features for use in a taxonomic reappraisal of the species of *Buddleia*, the pollen of some 300 gatherings, wild and cultivated, was examined. The findings brought out two marked features which Punt & Leenhouts (1967) failed to observe because of the fewer species they examined. To ease presentation at this stage, only pollen of cultivated plants of known chromosome numbers is discussed; voucher specimens of these (at E) are indicated in the table by the Edinburgh C. numbers.

The first of the features already mentioned is the pronounced relationship between the number of colpi and the degree of ploidy in the plant. The second is the relationship between grain size and the degree of ploidy, as first indicated by Moore (personal communications, 1967). This latter feature is by no means as well marked as the former but there does appear to be a basic underlying correlation and some discussion will be attempted on the exceptions. These two relationship patterns have been found in wild as well as in cultivated material.

Pollen may be speedily examined by mounting in Gurr's water-mount or in cotton-blue; the latter has the advantage of allowing the percentage of viable grains to be calculated. Grains were also germinated in a 5% or 7½% sugar solution in an inverted drop which sometimes made the colpi numbers more clearly visible and gave some estimate of potential pollen tube length. A few hundred permanent preparations were mounted in gentian-violet and subsequently more than 50 preparations were made using the acetolysis method of Erdtman (1960). With the exception of grains germinated in sugar solution, no significant size differences were observed between pollen treated by the various methods.

The mean of grain measurement was obtained through observations on 8 grains at their broadest diameter. Occasionally much larger than normal grains were observed and it was assumed that these were grains from pollen mother cells in which reduction division had failed.

It will be seen from the table on page 200 that, without exception, all diploid species are regularly 3-colporate. Tetraploid to 12-ploid species are 4-colporate with the exceptions of *B. indica* Lam. and *B. delavayi* Gagnep. The stocks of 16–24 ploid *B. colvilei* Hook f. & Thoms. produce a mixture of 4 and 5-colporate grains.

The basic pollen size/ploidy relationship would seem to be: diploids, 12–15μ; tetraploids, 16–20μ; hexaploids, 20–25μ; 12-ploids, 25–27μ and 16 and 24-ploids, 32–42μ.

That *B. indica* Lam. (*Nicodemia diversifolia* Tenore) should have a tetraploid count but tricolporate grains of normal diploid size is of interest. This is the first record of polyploidy in this genus from the African continent (Gadella, 1962) and was confirmed on a different clone, (Keenan, unpublished). It was thought that Gadella's count might have been based on polyploid cells which may sometimes be seen in division in root-tips, but

Species	C. No.	Area (As. = Asia Am. = America Af. = Africa)	Ploidy x = 19	Pollen Colpi No.	Pollen Size
alternifolia Maxim.	C. 428	As.	38 — 2x	3	12μ
asiatica Lour.	C. 595	As.	38 — 2x	3	12μ
auriculata Benth.	C. 305	Af.	38 — 2x	3	12μ
brasiliensis Jacq. f.	C.2318	Am.	38 — 2x	3	16μ
crispa Benth.	C. 304	As.	38 — 2x	3	14μ
farreri Balf. f. & W. W. Sm.	C.5865	As.	38 — 2x	3	14μ
globosa Hope	C. 10	Am.	38 — 2x	3	14μ
grandiflora Cham. & Schlect.	C. 359	Am.	38 — 2x	3	23–25μ
japonica Hemsl.	C. 9	As.	38 — 2x	3	14–16μ
lindleyana Fort. var. *sinuato-dentata* Hemsl.	C. 12	As.	38 — 2x	3	14–16μ
madagascariensis Lam.	C. 617	Af.	38 — 2x	3	12μ
nappii Lorenz.	C. 471	Am.	38 — 2x	3	14μ
neemda Buch.-Ham.	C.5866	As.	38 — 2x	3	14μ
paniculata Wall.	C.1204	As.	38 — 2x	3	14μ
salviifolia Lam.	C.3050	Af.	38 — 2x	3	15μ
scordioides H.B.K.	C.5876	Am.	38 — 2x	3	22μ
sterniana Cotton	C. 567	As.	38 — 2x	3	12–14μ
tibetica W. W. Sm.	C.1001	As.	38 — 2x	3	13μ
venenifera Makino	C.3014	As.	38 — 2x	3	16–20μ
americana L.	C.5868	Am.	76 — 4x	4	20μ
candida Dunn	C. 515	As.	76 — 4x	4	16μ
cordata H.B.K.	C.5869	Am.	76 — 4x	4	17μ
davidii Franch.	C. 3	As.	76 — 4x	4	16μ
fallowiana Balf. f. & W. W. Sm.	C. 513	As.	76 — 4x	4	19μ
fallowiana var. *alba*	C. 512	As.	76 — 4x	4	17μ
indica Lam.	C.5870	Af.	76 — 4x	3	12μ
parviflora H.B.K.	C.3362	Am.	76 — 4x	4	16μ
sessiliflora H.B.K.	C.5871	Am.	76 — 4x	4	16μ
albiflora Hemsl.	C. 1	As.	114 — 6x	4	23μ
delavayi L. F. Gagnep.	C. 596	As.	114 — 6x	3	17μ
forrestii Diels	C. 8	As.	114 — 6x	4	20μ
hookeri Marquand	C.3049	As.	114 — 6x	4	22μ
limitanea W. W. Sm.	C. 479	As.	114 — 6x	4	25μ
stenostachya Rehd. & Wils.	C. 14	As.	114 — 6x	4	20μ
sp. nov.	C. 11	As.	114 — 6x	4	22μ
nivea Duthie var. *yunnanensis* Rehd. & Wils.	C. 474	As.	228 — 12x	4	26–27μ
pterocaulis Jackson	C. 581	As.	228 — 12x	4	26–27μ
colvilei Hook. f. & Thoms.	C. 473	As.	304 — 16x	4–5	32–42μ
colvilei 'Howth Castle'	C. 2.	As.	456 — 24x	4–5	32–42μ

TABLE 1. Relationship between ploidy and pollen type in *Buddleia*.

this proved not to be so. Thus it appears, that at least in cultivation, *B. indica* Lam. is indeed a polyploid. The presence of tri-colporate pollen in both diploid and tetraploid berried buddleias might yet be used as a further generic distinction if the genus *Nicodemia* were to be restored.

Amongst the hexaploid species, *B. delavayi* Gagnep. is unusual in having tricolporate grains of a size normally found in tetraploids. *B. delavayi* shares with one other species—*B. heliophila* W. W. Sm.—a unique mode of flowering found nowhere else in the genus which suggests close relationship between the two. *B. heliophila* when examined appeared to have mixed 3–4-colporate grains of hexaploid size (20–25μ) but many were shrunken and others appeared empty. More observations will need to be made on these two species before profitable discussion may be undertaken.

Size of grain is quite obviously not the only factor determining the number of colpi for the diploid species *B. grandiflora* Cham. & Schlect., 23–25μ, *B. brasiliensis* Jacq., 17μ and *B. scordioides* H.B.K., 22μ, have grains as large as would accommodate 4 colpi in some other species.

It is worthy of note that both *B. grandiflora* and *B. brasiliensis* have long exserted styles as is also the case in the allied monotypic *Emorya* and grain size here may be associated with the necessarily longer pollen tubes. Such a hypothesis cannot be tendered in explanation of the remaining size exceptions amongst the diploid species but it is significant that they are all members of Series *Curviflorae* (Marquand, 1930)—a unique group of species with curved corollas. When the type specimen of *B. purdomii* W. W. Sm. was tested, it was found to be 3-colporate with a grain size of 17–19μ and thus all members of this series apparently share this feature of larger grain size.

It should be remarked that Nair (1965) states that *B. paniculata* Wall. was 4-colporate. Both Moore and the present writer found their two separate introductions to be diploid and 3-colporate and the several wild herbarium collections examined supported our findings on colpi number.

Finally, although it would be premature as yet to attempt discussion on the pollen characteristics of hybrids, there are some interesting features worthy of record. In some hybrids between diploid species, as for instance in *B. madagascariensis* × *crispa*, *B. crispa* × *paniculata* and *B. lindleyana* × *crispa*—where 3-colporate grains might be expected—mixed 3- and 4-colporate grains are found. *B. crispa* might appear to be the common factor of these hybrids responsible for the appearance of the 4-colporate state but pollen of the diploid cross *B. alternifolia* × *crispa* is constantly 3-colporate. In most hybrids involving diploids and polyploids the grains are 4-colporate but in *B. globosa* × *davidii* they are mixed 3- and 4-colporate.

To sum up it could be said that in general colpi number does not rigorously follow either ploidy level or grain size. Throughout the genus, diploid species have tricolporate grains whilst higher ploidy levels with the exceptions of *B. indica* Lam. and *B. delavayi* Gagnep. have 4- or 5-colporate grains. There are also patterns of relationship between grain size and ploidy level but again exceptions occur which may characterize complete species groups—as in Series *Curviflorae*—or may occur in isolated species of an otherwise regular group. In the latter case it is suggested that some exceptions may be correlated with specializations of pollination.

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