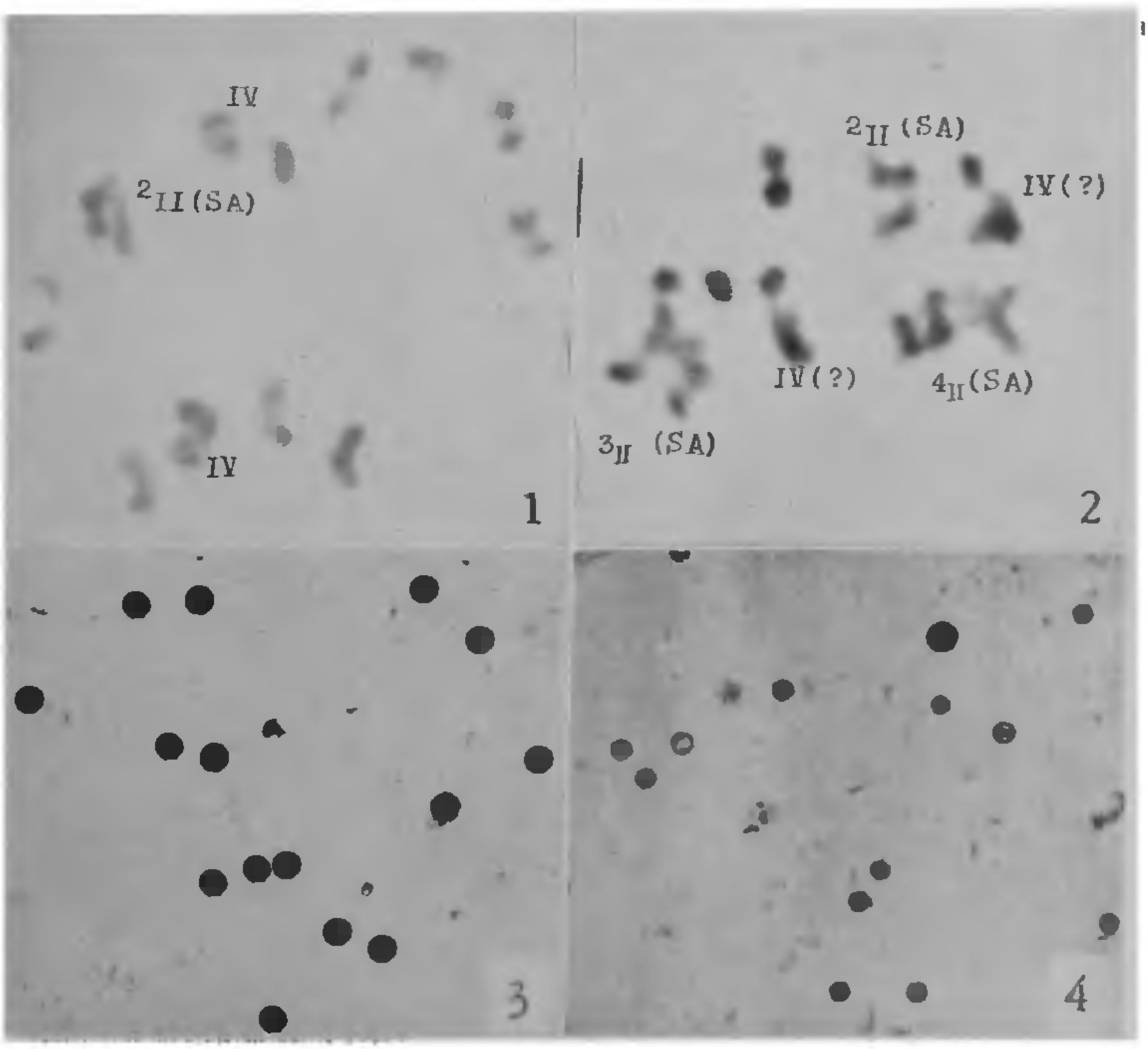
CYTOGENETICS OF THE INTERGENERIC HYBRID, *VACCARIA GRANDIFLORA* × *SAPONARIA VACCARIA*

T. N. KHOSHOO AND S. K. BHATIA
Botany Department, Panjab University, Chandigarh-3

EXCEPT for Graminæ and Orchidaceæ, intergeneric hybridization in angiosperms is very rare. If such hybrids are fertile and involve plant species properly placed in two different genera, it is logical to conclude about their close genetic relationship and, as such, validity of one of these becomes questionable. Such a situation is aptly true of the present hybrid.

Saponaria vaccaria Linn. (Caryophyllaceæ) is a very common winter-annual weed of cultivation in the North-Western India and Khoshoo[1] found $n = 15$ in this. This finding raised a measure of suspicion about the biosystematic identity of the species, because all the other species of the genus *Saponaria* possess $n = 14$.[2,3] In strong contrast to this, the species of the allied genus *Vaccaria*, possess exclusively $n = 15$.[2,3] In order to unravel the genetic relationships of *Saponaria vaccaria*, it was crossed extensively with members of the genera *Vaccaria* and *Saponaria*. While the details of these results, and implications thereof, of these experiments will appear elsewhere, it is of interest to report here on one of the hybrid combinations, *Vaccaria grandiflora* Jaub. and Spach. × *Saponaria vaccaria* Linn. Both these possess $2n = 30$ and $n = 15$. Karyotype in both is nearly similar and contains 6 sat-chromosomes. This fact fits very well with the earlier conclusion of Khoshoo[1] that the Silenoideæ with $n = 15$ are "cryptic polyploids", being at hexaploid level with $x = 5$. This is further confirmed by the presence of multivalent and secondary associations (Fig. 1). However, both the parents are perfectly fertile (Fig. 3). During meiosis, the hybrid shows a reduced degree of multivalent formation but there is pronounced increase in



FIGS. 1–4. **Figs. 1–2.** Metaphase I in *Saponaria vaccaria* and F_1 *Vaccaria grandiflora* × *S. vaccaria*. Both possess $n = 15$ and show multivalents and secondary associations (*S.A.*), particularly in the latter, × 3,000 **Figs. 3–4.** Pollen grains of *S. vaccaria* (94% stainable) and the F_1 (30%), × 100.

secondary associations (Fig. 2). Possibly some of the secondary associations are disjoined multivalents. These features reveal that there is not only good deal of homology between the chromosomes of the two parents, but there also exists a measure of structural hybridity. The anaphases are perfectly clean but the fertility is reduced (30% in pollen, Fig. 4 ; and 37% in seeds), which indicates that disharmonious combinations are formed as a result of the recombination between the parental chromosomes. Possibly there is good deal of cryptic structural hybridity and we are attempting a detailed pachytene analysis to unravel the extent and nature of such hybridity.

The F_1, F_2 and F_3 populations were raised and these are not only healthy and vigorous, but what is important, there is an increase in fertility from F_1 to F_3 (37 to 70% in seeds).

While *S. vaccaria* possesses no barriers to gene exchange at any stage when crossed with ***V. grandiflora***, it, however, is strongly isolated genetically from other members of the genus ***Saponaria*** possessing $n = 14$ (Fig. 5). This is a very strong genetic proof for the fact that even though the name *S. vaccaria* Linn. is very commonly used in floras, monographs and research papers all over the world, in genetical sense it is actually a member of genus *Vaccaria*. This conclusion is further corroborated by a critical morphological as well as chemical analyses of *S. vaccaria*. In all these features it resembles very closely the genus ***Vaccaria,*** rather than the genus ***Saponaria,*** a situation not accepted by Linnaeus.[4]

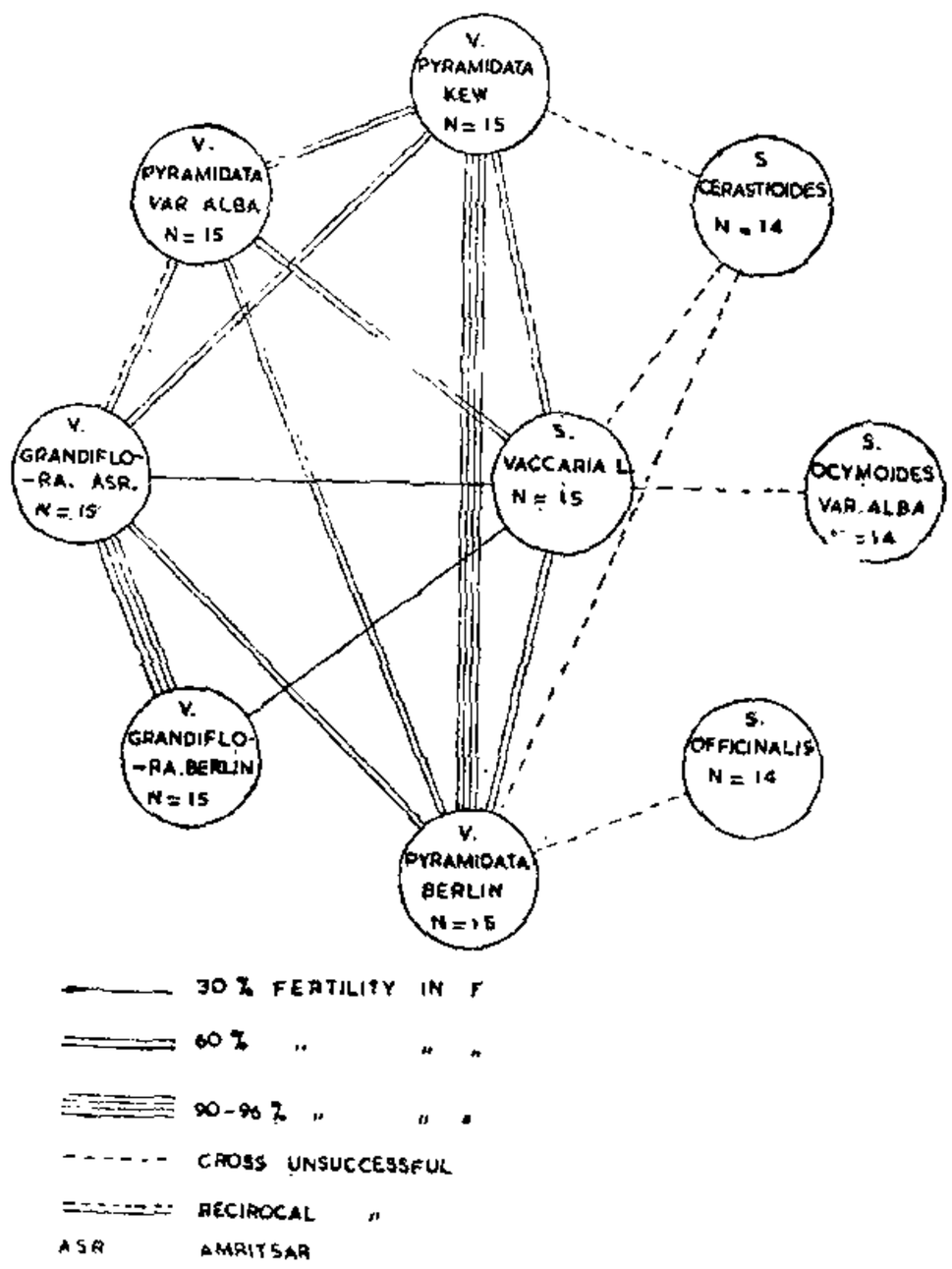


FIG. 5. Crossing polygon showing the genetic affinity of *Saponaria vaccaria*.

The genera *Vaccaria* and *Saponaria* as reconstituted now possess exclusively $n = 15$ and $n = 14$ respectively. Morphologically the former has inflated and 5-keeled calyx, non-appendaged petals and spherical seeds ; while the latter has cylindrical and keelless calyx, appendaged petals and kidney-shaped seeds. Furthermore, *Vaccaria* contains traces of Saponin, while *Saponaria* possesses it in copious amount.

In view of the fertile hybrids and lack of barriers to gene exchange between the two parents, speciation between the reconstituted genus *Vaccaria* poses an interesting problem. The present investigations reveal that the two species (*i.e.*, *S. vaccaria* and *V. grandiflora*) are separated on somewhat minor taxonomic characters. A genetical analysis of F_2 and F_3 reveals that there is strong linkage between the characters separating the two species. Speaking evolutionally there is a strong "coherence"[5] between the taxonomic characters. The mode of inheritance of such characters is complex. It may be pointed out that it is such characters that are of real taxonomic value because in spite of hybridization they tend to segregate together. To put it simply, the more the coherence between the taxonomic differences, the more reliable and useful these are to the taxonomist.

In the end, it may be pointed out that this is an addition to the few examples of intergeneric hybrids in dicotyledons,[6] where generic transfers have been made or are advocated on the basis of combined morphological, cytological and genetical study. Furthermore, such methods not only help in an understanding of the evolutionary processes, but also help in building classification which reflects the true evolutionary relationships of the taxa involved.

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