

ON THE INTERRELATIONSHIPS OF CERTAIN SPECIES OF PETUNIA IV. HYBRIDIZATION BETWEEN *P. LINEARIS* AND *P. CALYCINA* AND NOMENCLATORIAL CONSEQUENCES IN THE PETUNIA GROUP

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SUMMARY

Interspecific hybridization between the 18-chromosomes species *Petunia linearis* and *P. calycina* yields fertile and vigorous progeny. Analysis of meiotic prophase microsporocytes of the hybrids reveals bivalents with almost complete pairing, indicating large scale homology between both genomes. Moreover, they have a specific arrangement of petals in the flower bud. For these reasons, generic separation is proposed of the $2n = 18$ species and the $2n = 14$ species formerly referred to *Petunia*, the latter to be transferred to the genus *Stimoryne*, as *S. axillaris* (Lam.) Wijsman *comb. nov.*, *S. integrifolia* (Hook.) Wijsman *comb. nov.*, and *S. hybrida* (Hook.) Wijsman *comb. nov.* From analogy, all described species of *Petunia* remain in *Petunia* except four additional very rare species for which new combinations are proposed.

1. INTRODUCTION

In a former contribution (WIJSMAN et al. 1983), dealing with the relationships of *Petunia* species with 18 chromosomes (*P. linearis*, *P. calycina*, and *P. parviflora*) to species with 14 chromosomes (*P. axillaris*, *P. integrifolia*), it has been demonstrated that the genus *Petunia* comprises two species groups in an advanced degree of evolutionary divergence.

The latter two species easily cross when artificially pollinated and have given rise to the ample variation of the cultivated hybrid types called *Petunia hybrida* (Hook.) Vilm. Of the former three only *P. calycina* and *P. linearis* could be hybridized, but whether the hybrids were fertile and vigorous has not been shown.

The present paper presents a study on the latter hybrids and their progeny, as well as the behaviour of the parental chromosomes in the F_1 . In view of the relationships to other described species of *Petunia*, conclusions as to the status of the genus *Petunia* are drawn.

2. NAMES, MATERIAL, METHODS

2.1. Names

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The sources of the relevant names used in the text can be found in our previous papers (WIJSMAN 1982, WIJSMAN 1983, WIJSMAN et al. 1983). For a full synonymy we refer to FRIES (1911). Subsequently, species have been described by SMITH & DOWNS (1964) and synonymized by SMITH & DOWNS (1966). In addition: *Petunia hybrida* (Hook.) Vilm., Album Vilmorin (1858) no. 8.

Petunia violacea; hybrida Hook., Bot. Mag. 64 (1837)t.3556.

As to genera, Fries Lists the following synonyms:

Petunia Juss., Ann. Mus. Hist. Nat 2 (1803) 215–216; type species *P. parviflora* Juss.

Callibrachoa la Lave & Lexarza, Novorum vegetabilium descriptiones fasc. II(1825)3; type species *C. mexicana* la Lave & Lexarza, junior synonym of *Petunia parviflora* Juss.

Stimomphis Rafin., Fl. Tellur. III (1836) 76; type species *S. linearis* (Hook.) Rafin., basionym *Salpiglossis linearis* Hook., synonymous to *Petunia linearis* (Hook.) Paxt.

Stimoryne Rafin., Fl. Tellur. III (1836) 76; type species *S. purpurea* Rafin., nom. superfl. for *Salpiglossis integrifolia* Hook.

Leptophragma Benth. ex. Dunal in DC, Prod. XIII: 1 (1852) 578; type species *L. prostrata* (Hook. & Arnott) Benth. ex Dunal, basionym *Salpiglossis prostrata* Hook. & Arnott, Bot. Beech. Voy. (1841) 153, junior synonym of *Petunia parviflora* Juss.

2.2. Herbarium material

As to *P. linearis*, *P. calycina*, and *P. parviflora*, the material inspected has been mentioned by WIJSMAN et al. (1983). Other species of *Petunia* have been studied in the following herbaria: Kew (K), British Museum (BM), Leiden (L), Utrecht (U). In addition, some sheets from München (M), Geneva (G), and herbarium Wijsman were consulted. Own observations in the comparative sections (3.4, 3.5, 3.6) were based on the following field numbers (in alphabetic order of the species):

P. caesia: Smith & Klein 4079 (1958), S. Joaquim, Sa Catarina (L); Fiebrig 829 (1903), Tobati, Paraguay (L); Lourteig 2124, S. Joaquim, Sa Catarina (U); Pedersen 12713 (15-2-1979), Timbe do Sul, Sa Catarina (Wijsman).

P. ericaefolia: Lindeman & de Haas 2525 (1966), Rodovia do café, Parana (U); Hatschbach 11599 (1964), i bidem (U); idem 12820 (1965), Ponta Grossa, Parana (U); Dusen, 27-11-1908, Vila Velha, Parana (L).

P. heterophylla: Dusen, 17-11-1914, Jaguariabyva, Parana (L); Sellow 2397, Rio Grande do Sul (photograph of the lost type, also figured by Fries, 1911), G.

P. linearis: Pedersen 3733 (1956), Bella Vista, Corrientes (K, U); Pedersen 12678 (1980), Concepcion, Corrientes (Wijsman).

P. macrodactylon: Pedersen 12960 (14-11-1980), Colonia Habana, Corrientes (Wijsman).

P. paranensis: Lindeman & de Haas 2690 (1966), Vila Velha, Parana (U); ibidem 2531 (1966), Rodovia do café, Parana (U); Hatschbach 11597 (1964), ibidem (U); Dusen, 10-10-1908, Serrinha, Parana (L).

P. pygmaea: Rosengurtt PE5315 (1943), Flora, Uruguay (U); Herter 83912 (1928) sub nom. *P. viscidula*, Uruguay (U).

P. rupestris: Hatschbach 6586 (1959), Aratopo, Parana (L); idem 3955 (1957), Pirai do Sul, Parana (L).

P. sellowiana: Klein 4082 (1963), Curitiba, Sa Catarina (L); Klein 4505 (1963), Morro do Pinheiro Seco, Sa Catarina (L); Reitz & Klein 13377 (1962), Curitiba, Sa Catarina (L); Bornmüller 683 (1906), Rio Turvo, Rio Grande do Sul (M).

P. variabilis: Bornmüller 213 (1904), N. Württemberg, Rio Grande do Sul (U).

2.3. Living material

Line S11 (*P. linearis*) and accession S18 (*P. calycina*, maintained as cuttings since it is self-incompatible) have been crossed and yielded F1 and F2 generations. With respect to aestivation S19 (somatic hybrid *P. parviflora* + *P. axillaris* ssp. *parodii*) and described by POWER et al. (1980) has been studied.

2.4. Methods

Measurements of one of the upper leaves have been taken when the plants were in flower.

For making chromosome preparations of pollen mother cells, anthers were stained in ethanol-hydrochloric acid-carminum according to SNOW (1963) and squashed in diluted aceto-carminum (c. 0.5%). Preparations were made semi-permanent by sealing the coverslip with nail polish.

3. RESULTS

3.1. *P. linearis* × *P. calycina*, F₁ and F₂; metrical data

P. linearis has narrow, linear leaves, whereas *P. calycina* has ovate leaves. The hybrid (an F₁ consisting of several plants) is intermediate in this respect. In length, the leaves of the hybrid slightly exceed those of the parents, but they are not as broad as those of *P. calycina* (fig. 1). The flowers of the hybrid show the heavy venation of the *P. calycina* parent but the malvidin flower pigment of the *P. linearis* parent used (see WIJSMAN et al. 1983). We therefore conclude that the plants studied were true hybrids.

In the F₂ a wide range of leaf shapes has been found. However, the range of the length/width ratio is only slightly wider than in the F₁ hybrid (fig. 2). Maybe this can be explained by loss of extreme types, since of about twelve capsules sown the plants measured were the only ones germinating (c. 7%), even though gibberellic acid has been applied (cf. WIJSMAN et al. 1983).

3.2. Karyology

Figs. 3 a-d show meiocytes of anthers of the F₁ hybrid *P. linearis* × *P. calycina*. Chromosomes at pachytene exhibit clear differentiation of chromomeres along their lengths (figs. 3 a-c). Large chromomeres are located in the proximal regions,



Fig. 1. Habit of the two species *P. linearis* (left) and *P. calycina* (right), and their intermediate hybrid.

whereas smaller, but conspicuous ones are visible at the distal points of most chromosomes, which is indicated by arrows in the microphotographs. This pattern of heterochromatin distribution holds for both *P. linearis* and *P. calycina*. In the F_1 hybrids of these species, pachytene nuclei are normal and show almost complete synapsed bivalents. Some examples of heteromorphic pairing have been observed, mainly at the distal chromosome segments. Metaphase I nuclei reveal normal bivalents, occasionally one of them being heteromorphic (fig. 3d). Anaphases I and II are normal; neither lagging chromosomes nor bridges and fragments have been found.

3.3. Aestivation

The buds of the flowers of the three $2n = 18$ species, *P. linearis*, *P. calycina*, and *P. parviflora* are distinguished by one valve covering three petals, the cover being composed of two petals (see fig. 4, *P. linearis*). In this respect the three species differ from the parental species of the Garden Petunia, i.e., *P. axillaris* (Lam.) B. S. P. and *P. integrifolia* (Hook.) Schinz & Thellung, in which there is a cochlear corolla bud. A corolla bud externally covered by two fused petals as found in the $2n = 18$ species corresponds to the *Schizanthus* flower diagram of EICHLER (1978); the fold (the fused edges of two petals) stands before the smallest anther. However, Eichler's diagram of *P. nyctaginiflora* Juss. (= *P. axillaris*) agrees with the aestivation in *P. axillaris*, *P. integrifolia* and their hy-

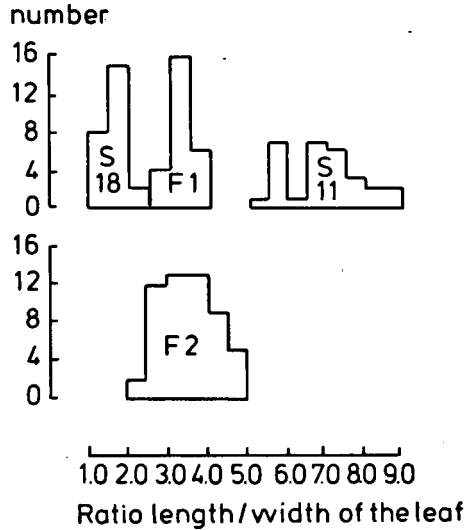


Fig. 2. Ratio of length and width of the leaf in parents, F₁, and F₂ of the cross *P. linearis* × *P. calycina*.

brid ($2n = 14$). One petal is the outermost one, a vein indicates the fold, and all five petal points are slightly contorted. Interestingly, Cocking's somatic hybrid (*P. parviflora* + *P. axillaris*) has flower buds with five radially folded terminally contorted petals much like in *P. axillaris*.

3.4. The position of other described species of *Petunia*

The impression has been formed that the species *P. linearis*, *P. calycina*, and *P. parviflora* are closely related to each other. Therefore, the question arises whether the other described species of *Petunia* might possibly bridge the gap between the three $2n = 18$ species and the *P. axillaris* / *P. integrifolia* $2n = 14$ complex. The latest reviewer, R. E. FRIES (1911), gives metrical data for all his 27 species. With the measurements, the $2n = 14$ species complex can be defined as: large herbs (stems over 40 cm); leaves softly herbaceous, oblanceolate, longer than 20 mm and wider than 10 mm with pointed tips and narrowing at the base into an alated petiole; flowers white or entirely purple, with tube length or total length as well as diameter more than 20 mm.

P. integrifolia var. *depauperata*, a degenerate form, may have very small leaves, while *P. integrifolia* ssp. *occidentalis* has a flower length of 18 mm, though on the other hand very large leaves.

The diagnosis as given excludes all other species mentioned by Fries, though in certain cases some of the latter share one or more of these characters with the $2n = 14$ group. The larger group of species including the three $2n = 18$ species can in its turn be characterized by the following diagnosis: small shrubs (only in some cases exceeding 40 cm); leaves linear or linear-spatheolate, obtuse,

Table 1. Species of *Petunia* mentioned by FRIES (1911), arranged where possible in small groups of species considered interrelated by Fries.

A. <i>P. caesia</i> , <i>P. linoides</i> , <i>P. regnelli</i> , <i>P. hassleriana</i> , <i>P. sendtneriana</i>	F. <i>P. ericaefolia</i> , <i>P. micrantha</i> , <i>P. helianthemoides</i>
B. <i>P. sellowiana</i> , <i>P. paranensis</i> , <i>P. rupestris</i>	G. <i>P. calycina</i>
C. <i>P. linearis</i> , <i>P. thymifolia</i> , <i>P. humilis</i> , <i>P. heterophylla</i>	H. <i>P. pubescens</i>
D. <i>P. parviflora</i>	I. <i>P. ledifolia</i>
E. <i>P. pygmaea</i>	J. <i>P. variabilis</i>
	K. <i>P. dusenii</i>
	L. <i>P. excellens</i>

sessile, shorter than 20 mm, narrower than 5 mm; flower limb white or purple with a yellow or at least pale tube with tube length or total length less than 18 mm and diameter less than 20 mm.

Among the latter group of species some deviate from the diagnosis in certain respects, but for reasons specified below we believe that the whole group represents a natural arrangement.

Since 1911, eight species have been described by SMITH & DOWNS (1964) and one more by SMITH & DOWNS (1966). In their key as well as in the description *P. reitzii*, *P. saxicola*, and *P. scheideana* are considered closely related to *P. integrifolia* and *P. axillaris*. *P. reitzii* has narrow leaves but in the attenuate form these resemble those of *P. integrifolia*. *P. saxicola* has a long flower tube with short limb. To these species can perhaps be added *P. littoralis*, joining them in the key though the leaves are narrow. It is a specialized species of the sandy sea coast, with long prostrate stems that seem to creep and occasional flowers with two erect leaves at the basis. The flowers are of the large and wide type. Smith and Downs are not very communicative as to the colour of the flowers of their species.

Of the nine species, this leaves five considered by Smith and Downs to be related to species of the large complex including the $2n = 18$ species.

3.5. Former subdivision of *Petunia* s.l.

Fries (1911) has described two subgenera; he gives no key, only a very short diagnosis. White flowers with a narrow flower tube characterize the subgenus *Pseudonicotiana*; all other species are combined as *Eupetunia*. Because the flower colour difference between *P. axillaris* and *P. integrifolia* is monofactorially determined (WIJSMAN 1983), while the difference in flower morphology may be based on a fairly restricted number of loci (WIJSMAN & HENDRIKS, in prep.), we do not think a subdivision based on these traits, separating two species that can be hybridized so easily, is a natural classification.

Eupetunia is divided by Fries in two groups on the basis of a more or a less deep incision of the calyx. The same major division is followed by SMITH & DOWNS (1966). The two groups are essentially the $2n = 14$ and $2n = 18$ group, with the important exception that *P. parviflora* ($2n = 18$) would be classified with the former species. However, this is partly an artefact. Though *P. parviflora*

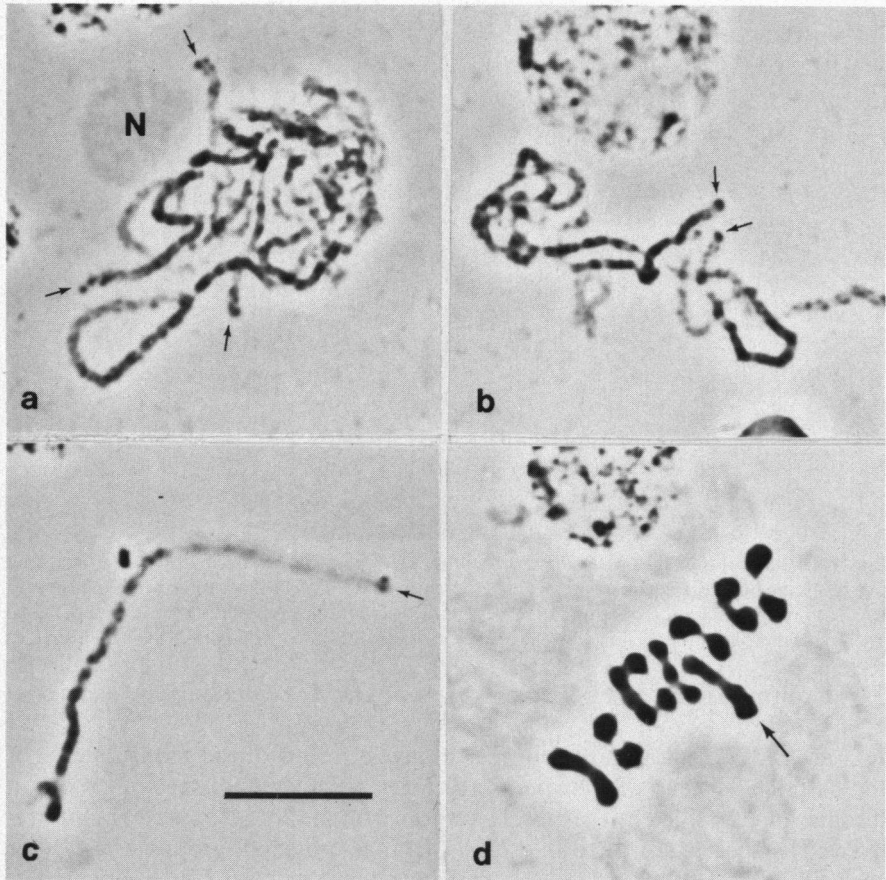


Fig. 3. Meiosis of the F_1 hybrid *P. linearis* \times *P. calycina*. a. Complete pachytene nucleus. Most bivalents are tangled, forming a dense clew. The chromosomes that are extruded from the knot show clear telomeres (arrows). Notice the heteromorphic patterns of some distal chromomeres. N = Nucleolus. b. Some bivalents with densely stained telomeres. c. The putative NOR (= nucleolar organizer region) bivalent containing abundant chromomeres at the proximal region and the NOR. The long arm possesses an obvious telomere. d. Metaphase I nucleus. One bivalent is heteromorphic (arrow). The bar equals 10 μ m.

shares the character that the greatest width of the calyx lobes is about halfway, in the living plant the incisions between the lobes are maximally 0.6 of the total length (that is, the calyces are pentafid instead of pentapartite). However, because the connection of the lobes is partly formed by a more or less diaphanous membrane, the green parts, and therefore the lobes as present in mounted material, exceed the size of the calyx tube greatly. The $2n = 14$ species do not possess such membranes, nor do *P. linearis* or *P. calycina*.

We conclude, therefore, that the two groups corresponding to the diagnoses above have been recognized by former reviewers.

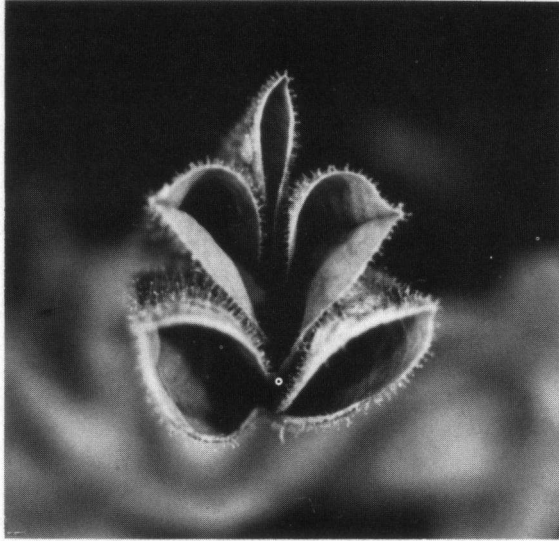


Fig. 4. Opening flower bud of *P. linearis* to show the type of aestivation. In a former stage all five petals are linearly folded and pressed together into a flat bud. The inner three petals are covered by the two lower petals. The lower tube has more or less radial venation, so in the upper tube at one side there is a little torsion where the venes at the tips of the covering petals have to divert.

3.6. Comments on the relationships of the various other described species.

It is not the present authors' purpose to give a review of the specific status of the described species of *Petunia*. R. E. Fries considered all species known in his time and classified by the present authors with the $2n = 18$ species as interrelated. The species are listed in *table 1*, arranged in small groups where Fries speaks explicitly of related taxa (normally he uses the word "Artenserie"). The following comments can be made.

SMITH & DOWNS (1966) have synonymized *P. excellens*, *P. linoides* and *P. regnelli*, therefore linking up group L with group A.

Fries considers groups B and C as closely related but mentions as a difference that the calyx lobes of group B are somewhat broader and more triangular than those in group A and that the stigma is inconspicuous. However, as to the style, even the character of a forked versus an entire stigma has been discarded by SMITH & DOWNS when they synonymized *P. excellens* and *P. linoides* as mentioned above. The curved style in the form of a question mark as observed in the three living $2n = 18$ species studied does not show up very clearly in Fries' figures based on soaked specimens; accordingly, the character of the stigma being of a more or less "pronounced" form must not get much weight. Our own observations point to close interrelationships of all seven species of groups B and C. *Petunia humilis* was inspected, but all others share the "heterophyllous" habit, that is, small tufts of short leaflets near the basis of the leaves. This can be conspicuous in old plant parts; some of the phenomenon can be seen in *fig.*

1. *P. heterophylla* may in fact be a synonym of *P. linearis*; it may be an adaptational form of open sand, with smaller and sparser leaves.

Together with the species of group B/C can be classified *P. parviflora* and *P. pygmaea* because of the linear sessile leaves, heterophylly, and form and colour of the flowers (WIJSMAN et al. 1983). Personal inspection has convinced us that Fries was not right in stressing the narrow flower tube and the white colour as characters linking *P. pygmaea* to *P. axillaris*. Vegetatively, *P. pygmaea* has *P. parviflora*/*P. linearis*-like leaves, heterophylly, and the same overall prostrate habit with small linear, sessile leaves as *P. parviflora*.

As to interrelationships of group A with group B/C, we may compare, for instance, *P. caesia* and *P. linearis*. The former is more like a small tree, the latter nearly a herb. Moreover, the leaves of *P. caesia* are more sclerophyllous. In spite of this profound difference at the species level, the two species are related to each other in the linear shape of the leaves, colour, size, and form of the flower and, in particular, in sharing heterophylly.

Group F is characterized by being shrubs with small sclerophyllous leaves of which the margins are curved down, small flowers, and a style carrying a disciform stigma. In Fries' figures, however, the latter character is not very clear. In spite of the extremely ericoid habit of *P. ericaefolia*, it shares in our opinion the heterophyllous character with group B/C. According to Fries *P. helianthemoides* resembles *P. calycina* (group G), from which, however, it differs by the pointed and imbricate shape of the slips of the flower limb.

This leaves the species listed under the letters G–K, of which Fries judges the first three as more or less isolated. *P. calycina* can hybridize with *P. linearis* and give fertile progeny (see section 3.1). This is interesting because vegetatively they seem very different (WIJSMAN et al. 1983). *P. pubescens* is connected with *P. calycina* by Fries on the basis of trumpet-like short flowers and more or less ovate leaves, *P. ledifolia* according to Fries occupies an isolated position. The sclerophyllous leaves with their margins curved downwards do not resemble the $2n = 14$ species in any way; the colour of the flowers and the form of the calyx are like the $2n = 18$ species.

Fries considers the species under J and K as related because they share the character of a forked stigma. As to this point, SMITH & DOWNS (1966) have synonymized *P. excellens* with a forked stigma with *P. linoides* with a disciform stigma (see above). *P. variabilis* and *P. dusenii* are described as very different. *P. variabilis* (own observations) is a shrub, but resembles *P. integrifolia* in the size of leaves and flowers; moreover the whole flower is purple. However, the leaves are more elliptic without acuminate ends, and in these respects as well as in the form of the calyx, the species resembles *P. calycina*. We did not inspect material of *P. dusenii*. Anyhow, the order in which Fries has listed his species reflects more or less his ideas about their relationships and accordingly he considers *P. dusenii* as least related to *P. axillaris* of all species mentioned.

The conclusion as to Fries' species must be that all are related to *P. calycina*, *P. linearis*, and *P. parviflora* or, if the evidence is too scant, that at least they have less in common with the $2n = 14$ species than with the $2n = 18$ species.

For none of the species of the above survey, aestivation characteristics have been mentioned. Even in living plants in full flower only a few buds are in the right stage for showing aestivation details. As to herbarium material, the number of sheets is anyhow limited and, therefore, the number of buds with indicative potential negligible, when they still must be able to stand soaking.

4. DISCUSSION

We have shown that *P. calycina* and *P. linearis* can be hybridized and that the hybrids are vigorous and fertile. Apart from difficulties in germination, a normal F_2 has been obtained with, however, a range of variation rather resembling that of the F_1 than the extremes of the parental types. Perhaps, the more (heterozygous) hybrid characters a plant has, the easier it overcomes the germination barrier.

In the F_1 hybrids, meiotic prophase stages could reveal some interesting details of chromosome pairing and structure. The almost completely synapsed pachytene chromosomes and the formation of normal bivalents at metaphase I suggest that both genomes are highly homologous. Bivalents at pachytene show many chromomeres of different size and located all along the chromosome. The larger heterochromatin blocks occur at the centromere region, but in some of the chromosomes conspicuous single chromomeres can be seen at the distal ends. The presence of this telomeric heterochromatin apparently corresponds to the distal C-bands in metaphase chromosomes as demonstrated in a previous paper (WIJSMAN et al. 1983). These results when compared with the karyotype of *P. hybrida*, where C-bands occur only proximately (DIETRICH et al. 1981), once again confirm the previously demonstrated differences in chromosome morphology and karyotypes between the 18-chromosome species and *P. hybrida* (WHITE & REES 1983; WIJSMAN et al. 1983).

The extensive comparative analysis of chromosome morphology in Solanaceae by GOTTSCHALK (1953) revealed that *P. hybrida* holds a particular position for two reasons: 1) its number of chromosomes, $2n = 14$, which is the lowest in the family, and 2) the extremely high number of chromomeres at pachytene. Now we can add the absence of telomeric heterochromatin, which does occur in the 18-chromosomes *Petunia* species and several other well-studied Solanaceous plants, like tomato (cf. BROWN 1966) and potato (RAMANNA & WAGENVOORT 1976) and in some *Nicotiana* species. In the latter, telomeric heterochromatin has been demonstrated in pachytene nuclei (BURNS 1966) as well as in C-banding studies (L. P. Pijnacker, pers. comm.). In conclusion, there are several arguments based on chromosome morphology and karyotype analysis, that permit a phylogenetic separation of the 14-chromosomes species from the 18-chromosomes *Petunia* species. The suggestion of WIJSMAN et al. (1983) has been confirmed that the difference between the $2n = 18$ and the $2n = 14$ species as traditionally united in the genus *Petunia* Juss. (type species: *P. parviflora* Juss.) is considerable. In addition to genetic data and to the general difference in habit, it is now shown that flower bud aestivation distinguishes the three $2n = 18$

species from the $2n = 14$ species. Even without study of the chromosomes, on the basis of a preliminary survey of the other species in *Petunia*, it does not seem likely that more species will have to be included into the $2n = 14$ complex except for *P. reitzii*, *P. saxicola*, *P. scheideana*, and *P. littoralis*, all of them described recently by Smith and Downs, endemics of Santa Catarina (Brazil) and known each from one locality only.

The arguments plead for separation of the $2n = 14$ species from the genus *Petunia* and grouping them into a genus for which the oldest available name is *Stimoryne* Rafin. The difference between the two genera can be expressed in the diagnoses of section 3.4, the first relating to *Stimoryne*, the latter one to *Petunia*. Unfortunately, the present rules of botanic nomenclature therefore necessitate coining a new latin name combination for the Garden 'Petunia'. The changes in name, then, are the following:

Stimoryne Rafin., Florin Telluriana III (1836) 76. Type species: *S. purpurea* Rafin., nom. superfl. for *Salpiglossis integrifolia* Hook., Bot. Mag. 58 (1831) t. 3113. No generic synonyms known.

Stimoryne integrifolia (Hook.) Wijsman *comb. nov.*

Basionym: *Salpiglossis integrifolia* Hook., l.c.; for further synonyms see WIJSMAN (1982) and FRIES (1911).

Subspecies:

Stimoryne integrifolia (Hook.) Wijsman ssp. *integrifolia*

Stimoryne integrifolia (Hook.) Wijsman ssp. *inflata* (R. E. Fries) Wijsman *comb. nov.*

Basionym: *Petunia inflata* R. E. Fries, Kungl. Svensk, Akad. Handl. 45(5) (1911) 35

Stimoryne integrifolia (Hook.) Wijsman ssp. *occidentalis* (R. E. Fries) Wijsman *comb. nov.*

Basionym: *Petunia occidentalis* R. E. Fries, l.c., 37

Stimoryne axillaris (Lam.) Wijsman *comb. nov.*

Basionym: *Nicotiana axillaris* Lam., Tableau encycl. method. botan. 2 (1793); for further synonyms see FRIES (1911).

Subspecies:

Stimoryne axillaris (Lam.) Wijsman ssp. *axillaris*

Stimoryne axillaris (Lam.) Wijsman ssp. *parodii* (Steere) Wijsman *comb. nov.*

Basionym: *Petunia parodii* Steere, Pap. Mich. Acad. Sci., Arts & Lett. 13 (1931) 213.

The hybrid *S. integrifolia* × *S. axillaris* (never found in the wild) as well as its many derivative cultivars now known as *Petunia hybrida* should be named:

Stimoryne hybrida (Hook.) Wijsman *comb. nov.*

Basionym: *Petunia violacea; hybrida* Hook., Bot. Mag 64 (1837) t. 3556.

Stimoryne reitzii (Smith & Downs) Wijsman *comb. nov.*

Basionym: *Petunia reitzii* Smith & Downs, Phytologia 10 (1964) 439.

Stimoryne saxicola (Smith & Downs) Wijsman *comb. nov.*

Basionym: *Petunia saxicola* Smith & Downs, Phytologia 10 (1964) 439.

Stimoryne scheideana (Smith & Downs) Wijsman *comb. nov.*

Basionym: *Petunia scheideana* Smith & Downs, *Phytologia* 10 (1964) 439–440.

Stimoryne littoralis (Smith & Downs) Wijisman *comb. nov.*

Basionym: *Petunia littoralis* Smith & Downs, *in: Solanaceas; Flora Illustrada Catarinense* (1966) 269–270.

If we compare the presently proposed classification to the one currently in use with *Nicotiana*, as based on the monograph by T. H. GOODSPEED (1954), in *Nicotiana* subgenera and sections are known comprising groups of species with in two sections highly divergent chromosome numbers, but in all others the number based on 24 or 48. Intrasectional hybrids in general show good pairing of chromosomes in the meiosis, intersectional hybrids in general minimum pairing. However, several combinations seem to bridge the discontinuities between sections, while two sections are even labelled intersubgeneric. This means that *Nicotiana* is a large aggregate of related species in all stadia of differentiation, and whereas the extremes are very different, it is impossible to draw lines of demarcation. In *Petunia* s.l., by contrast, there are two clear-cut groups without borderline cases. Therefore, we think generic rather than subgeneric rank should be given to each of these. The genus *Stimoryne* might in fact be closer related to *Nicotiana* and/or other Solanaceous genera than to *Petunia* s.s. The relationships to *Nicotiana* would be based on the reduced leaves of the shoots carrying the large flowers, strongly suggesting the leafless panicles of *Nicotiana*, as well as on the flowers of *P. axillaris*, with narrow long tubes like those of *Nicotiana* subg. *Petunioides*. The number of genes determining the differences within *Stimoryne* of the wide flower tube and the narrow flower tube is currently under investigation (WIJSMAN & HENDRIKS, in prep.).

We hope our investigations shall be useful for basic research studies (e.g., interspecific or “intergeneric” gene transfer, phylogenetic aspects of molecular homology of genes), important as these seem bound to become in Solanaceae in general and in *Stimoryne hybrida* in particular.

REFERENCES

- BROWN, S. W. (1966): Heterochromatin. *Science* 151: 417–425.
- BURNS, J. A. (1966). The heterochromatin of two species of *Nicotiana*. *J. Hered.* 57: 43–47.
- DIETRICH, A. J. J., J. H. DE JONG & R. J. P. MULDER (1981): Location and variation of the constitutive heterochromatin in *Petunia hybrida*. *Genetica* 55: 85–91.
- EICHLER, A. (1878). *Blütendiagramme*, Leipzig.
- FRIES, R. E. (1911): Die Arten der Gattung *Petunia*. *Kungl. Svensk. Vetensk. Akad. Handl.* 46 (5): 1–72.
- GOODSPEED, T. H. (1954): *The genus Nicotiana*. Chronica Botanica, Waltham.
- GOTTSCHALK, W. (1953): Die Chromosomenstruktur der Solanaceen unter Berücksichtigung phylogenetischer Fragestellungen. *Chromosoma* 6: 539–626.
- POWER, J. B., S. F. BERRY, J. V. CHAPMAN & E. C. COCKING (1980): Somatic hybridization of sexually incompatible *Petunias*: *Petunia parodii*, *Petunia parviflora*. *Theor. Appl. Genet.* 57: 1–4.
- RAMANNA, M. S. & M. WAGENVOORT (1976): Identification of the trisomic series in diploid *Solanum tuberosum* L. group *Tuberosum*. I. Chromosome identification *Euphytica* 25: 233–240.
- SMITH, L. B. & R. J. DOWNS (1964): Notes on the Solanaceae of Southern Brazil. *Phytologia* 10: 422–453.

- & — (1966): *Solanaceas; Flora Illustrada Catarinense*. Cons. Nac. Presq. Itajai (Sa Cat.)
- SNOW, R. (1963): Alcoholic hydrochloric acid-carmines as a stain for chromosomes in squash preparations. *Stain Technol.* **38**: 9–13.
- WHITE, J. A. & H. REES (1983): Cytology of a *Petunia* somatic hybrid. *Kew Chromosome Conference II*: 372. George Allen & Unwin, London.
- WIJSMAN, H. J. W. (1982): On the interrelationships of certain species of *Petunia*. I. Taxonomic notes on the parental species of *Petunia hybrida*. *Acta Bot. Neerl.* **31**: 477–490.
- (1983): On the interrelationships of certain species of *Petunia*. II. Experimental data: crosses between different taxa. *Acta Bot. Neerl.* **32**: 97–107.
- , J. H. DE JONG & T. M. PEDERSEN (1983): On the interrelationships of certain species of *Petunia*. III. The position of *P. linearis* and *P. calycina*. *Acta Bot. Neerl.* **32**: 323–332.