Chromosome Numbers of Some of the Cactaceae
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CHROMOSOME NUMBERS OF SOME OF THE CACTACEAE

PALMER STOCKWELL

(WITH SEVENTEEN FIGURES)

Continuing his interest in the cacti (**8**), the writer has begun a cytological investigation of them, believing that studies of the chromosome numbers of this group might aid in the solution of its taxonomic problems. This paper is a report of preliminary findings in this direction.

Root tips of available species were fixed in a chromo-acetic-formalin mixture used in this laboratory. This formula is designated as CL_9 and is as follows:

SOLUTION A, 2 PARTS	SOLUTION B, 1 PART
100 cc. distilled water	0.5 gm. saponin
10 cc. glacial acetic acid	100 cc. 16% formalin solution
1 gm. chromic acid	
1 gm. potassium dichromate	
1 gm. urea	

(Mix solutions A and B immediately before use.)

The slides were stained with gentian violet, safranin, and orange G as described in a previous paper (**7**). With this procedure no particular difficulty was encountered in counting the chomosomes.

Eight species or forms of *Opuntia*, one of the more primitive groups of the cacti, were examined. These plants of the flat-jointed, prickly pear type had been transplanted from their natural habitats and kept in cultivation for different periods of time varying from a few months to several years. Of the tribe Cereeae, a highly evolved group, nine species were investigated, most of them being greenhouse seedlings. They included specimens of the giant cactus of the southwestern United States (*Carnegia*); a giant cactus of northern Mexico (*Lophocereus*); one of the Christmas cacti, an epiphytic form from Brazil (*Schlumbergeria*); one of the porcupine cacti of the California ture locules are practically filled with the closely packed, crowded seeds, they contain in the interstices a clear, transparent mucilage, hard and brittle in the mature dry fruit but rapidly absorbing water and swelling into a soft gelatinous mass when dampened. Each seed is invested by a somewhat denser sheath of the mucilage. This mucilage is derived earlier in the development from glandular hairs at the base of the ovules. As a rule all the ovaries on the spadix develop seeds, although occasionally there is some abortion.

MÜCKE's (4) brief description of the fruit of Asiatic *Acorus calamus* is essentially in agreement with this, except that he found fewer

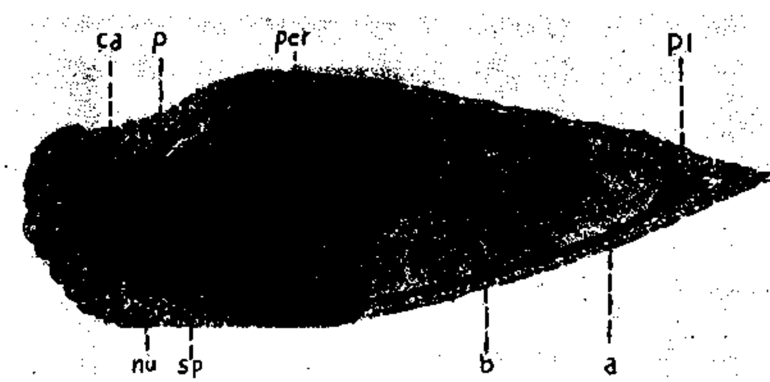


FIG. 1.—Longitudinal section of seed of *Acorus calamus*. ×31

seeds (2–5) in each fruit. EATON (2) likewise described *Acorus* fruit as fewer seeded. Both BRITTON (1) and SMALL (5) describe *Acorus* fruit as "2–3-celled," but in the present material it is regularly 3-celled; empty locules of semi-abortive fruits may readily be overlooked in the dry condition.

The orthotropous seeds are 3–4 mm. long, narrowly ovoid, and somewhat angled as a result of crowding. The chalaza tapers into the short funiculus which may be either straight or curved or nearly absent, depending upon the position of the individual seed in the locule. The outer surface is light brown, speckled with dark brown indentations. Under the microscope it glistens owing to the air filled parenchyma cells that make up the tissue of the testa. This is 3–4 cells thick, soft, spongy, and easily scraped away. When cut bers. In the species *Opuntia polyacantha*, chromosomes have been counted in specimens from Colorado, Saskatchewan, southern Alberta, and Peace River Crossing in northern Alberta near the station

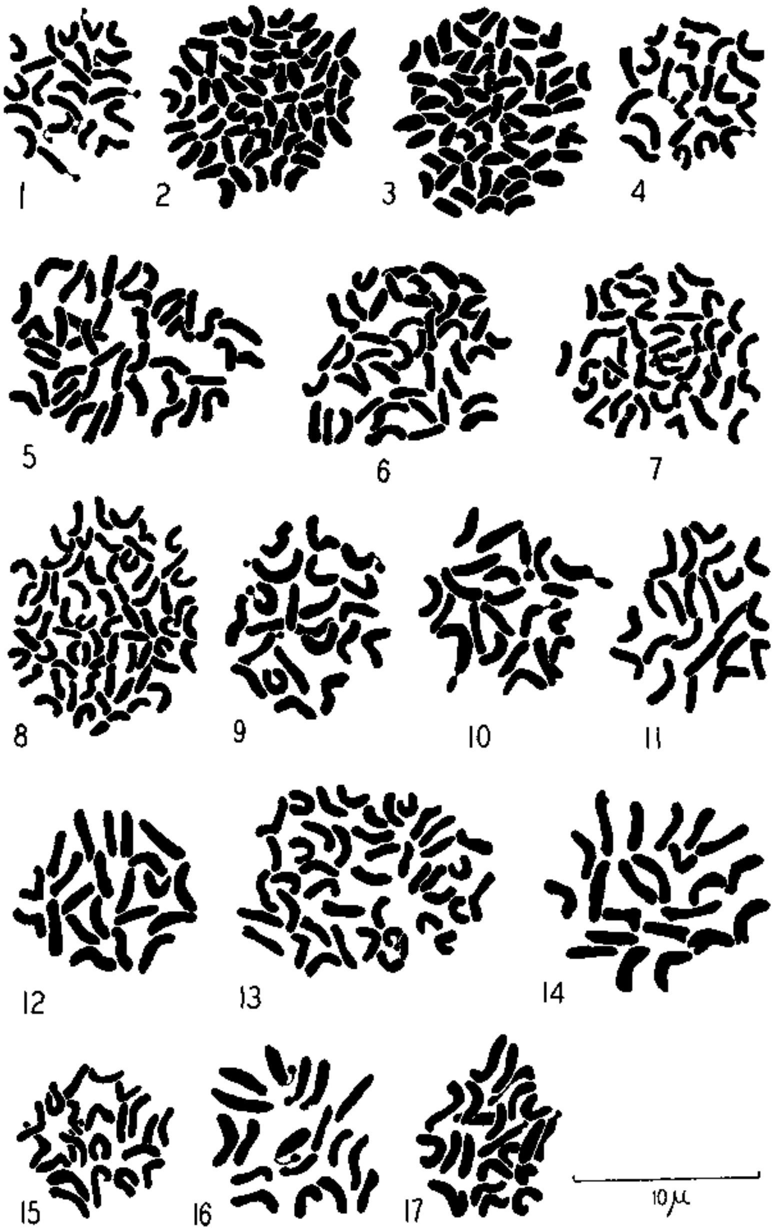
TABLE I

KNOWN SOMATIC CHROMOSOME NUMBERS IN CACTACEAE

Figure no.	Name	Approximate distribution	2n
	Tribe Opuntieae		
1	Opuntia santa-rita (G. & H.) Rose	Southern Arizona and northern Mexico	22
2	O. phaeacantha Engelm.	Texas to California and northern Mexico	±66
3	O. discata Griffiths	Southern Arizona	±66
4	O. chlorotica Engelm.	New Mexico to California	22
5	O. polyacantha Haw.—Colorado Springs	New Mexico to California and north to Canada	44
6	O. polyacantha Haw.—Saskatoon, Saskatchewan	New Mexico to California and north to Canada	44
7	O. polyacantha Haw.—Southern Alberta	New Mexico to California and north to Canada	44
8	O. polyacantha Haw.—Peace River, northern Alberta	New Mexico to California and north to Canada	±66
*	O. brasiliensis (Willd.) Haw.	Brazil	22
	Tribe Cereeae		
9	Carnegia gigantea (Engelm.) B. & R.	Arizona and northern Mexico	22
10	Lophocereus schottii (Engelm.) B. & R.	Northern Mexico	22
11	Echinopsis multiplex (Pfeif.) Zucc.	Brazil	22
†	Zygocactus truncata Schum.	Brazil	24
12	Schlumbergeria russelliana (Gard.) B. & R.	Brazil	22
13	Echinocereus engelmannii (Parry) Rump.	New Mexico to California and northern Mexico	44
14	Ferocactus rostii B. & R.	Southeastern California	22
15	Neomammillaria macdougalii (Rose) B. & R.	Arizona	22
16	N. applanata (Engelm.) B. & R.	Texas	18
17	N. fragilis (Salm-Dyck) B. & R.	Mexico	22
†	N. glochidiata (Mart.) B. & R.	Southern Mexico	24

* Counted by JOHANSEN (5).
† Counted by SUGIURA (9).

for the northernmost collection of cactus known. Of these, the northernmost form, much smaller than its more southern relatives and with smoother pads and fewer spines, had the somatic number 66



FIGS. 1–17.—Somatic chromosome plates from root tips of various cactus species. The numbers correspond to those of table I.

10 days. The radicle is forced through the micropyle as the cotyledon begins to elongate. Almost immediately the radicle turns downward so that the rapidly developing primary root is directly established in the soil (fig. 3 *A*, *B*). Simultaneously with commencement

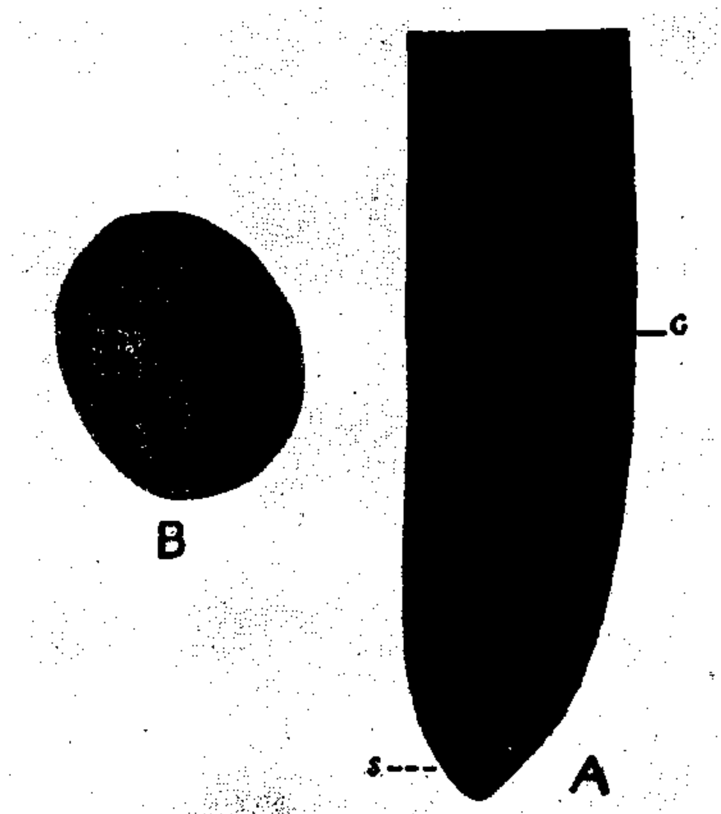


FIG. 2.—*A*, longitudinal section of embryo between *a* and *b* of fig. 1; *B*, cross section of embryo at *c* in adjacent figure. ×150.

of root growth the hypocotyl begins to enlarge slightly (fig. 3 *A*, *sw*), and at this swelling appears a band of hairs, which doubtless serve as auxiliary organs to absorb water and minerals while the primary root is yet in its embryonic stages (fig. 3 *B*, *C*, *D*, *h*). These primary absorbing organs, together with the immediate production of chlororain forests, and are among the few representatives of the plant kingdom in certain parts of the desert, it is expected that a more exhaustive research from this viewpoint may prove a valuable approach to the problems of plant distribution and the species question.

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