BIOSYSTEMATICS OF SETCREASEA BREVIFOLIA

S. A. FARUQI[1] AND K. L. MEHRA[2]

Setcreasea brevifolia (Torr.) Schum. & Sydow is a highly polymorphic and poorly understood species distributed in northern Mexico and southern Texas. Rose (1899, 1903, 1911) and Matuda (1955) included several taxa as synonyms of *S. brevifolia*, without indicating their similarities or differences. The similarities between certain taxa are so strong that for almost sixty years *S. ovata* (Coulter) Faruqi, Celarier & Mehra (Syn. *Tradescantia leiandra* var. *ovata* Coulter, Contr. U. S. Nat. Herb., 1: 50. 1890) was regarded as a synonym of *S. brevifolia* (Torr.) Schum. & Sydow. Floral morphology and crossing data suggested that *S. ovata* Faruqi et al. is related to the *S. pallida* Rose — *S. purpurea* Boom group and that it is not in the direct evolutionary line of *S. brevifolia* (Faruqi et al., 1962). Another taxon, *Tradescantia speciosa* Buckley, considered by Rose (1899, 1911) and Matuda (1955) as a synonym of *S. brevifolia* and treated as *S. buckleyi* Johnst. (Johnston, 1944) needs taxonomic consideration since no barriers to crossability exist between these taxa and the distinction between them is ecological and morphological (Faruqi and Mehra, 1966). Furthermore, a few other taxa have never been mentioned or included within *S. brevifolia* in spite of their resemblance to this species. One such taxon was collected from the Ottine Swamp of Gonzales Co. in Texas. Its plants were very small, hardly six inches tall and with very narrow leaves. A similar plant from an unknown locality was present in our living collection and it was crossed with *S. brevifolia*. The F_1 hybrid resembled other plants from our living culture and herbarium collections. One of the herbarium sheets resembling this hybrid was annotated with a name by Bartell, but it was never pub-

[1]Permanent address: Senior Lecturer, Dept. of Botany, University of Karachi, Karachi, W. Pakistan.

[2]Permanent address: Head, Division of Plant Improvement, Indian Grassland & Fodder Research Institute, Jhansi, U.P., India.

lished. It is important to note that all of the foresaid taxa except *S. ovata* are characterized by narrow connectives and pubescent ovary. Whether these taxa should be included within *S. brevifolia* or should be treated as different species needs consideration. Besides, the origin of these variations should also be considered. Biosystematic studies were, therefore, undertaken on living and herbarium specimens and four varieties were recognized within *S. brevifolia* (Torr.) Schum. & Sydow. The results are reported in this paper.

Setcreasea brevifolia (Torr.) Schum. & Sydow, in Just, Bot. Jahrb. 27(1) : 452. 1899 (1901).

Syn. *Tradescantia leiandra* var. *brevifolia* Torr., in Emory, U. S. and Mex. Bound. Survey, 225. 1859.

Zebrina (?) *leiandra* Clark, in DC. Monograph. Phan. 3: 318. 1881.

Tradescantia leiandra Wats., Proc. Amer. Acad. 18: 167. 1883.

Tradescantia brevifolia Rose, Contr. Nat. Herb. 3: 323, *pl. 16*. 1895.

Treleasea brevifolia Rose, Contr. Nat. Herb. 5: 207. 1899.

Neotreleasea brevifolia Rose, Contr. Nat. Herb. 8: 6. 1903.

Stem 8-30 cm in height; sepals 3; petals 3; stamens 6, epipetalous, connectives thick and narrow; and ovary pubescent.

Four varieties were recognized within *S. brevifolia*. The stem is unbranched and the leaves are 3-4 cm long in var. 1- *nanella*. The stems are branched and the lengths of the leaves are 5-6 cm in var. 2- *pulchella*, 7-10 cm in var. 3- *brevifolia* and 10-13 cm in var. 4- *buckleyi*.

1. *S. brevifolia* var. *nanella* Faruqi et Mehra, var. nov.

Caule non ramoso, erecto, 10-20 cm alto; folia lanceolata vel elliptico — lanceolata, viridia, 3-4 cm longa, 1-2 cm lata.

HOLOTYPE: U.S.A. TEXAS, GONZALES CO., Ottine Swamp, *Cory* 14581 (GH). MEXICO: D.F. MEXICO: Raynosa, *Runyon* 20 (US); *Clover* 1932, cultivated (MICH).

Cultivated: *Setcreasea* Taxon-1 (Mehra et al., 1961).

Faruqi and Mehra (1967) reported that some kind of genetic barrier seems to exist between the varieties *brevifolia* and *nanella* since only three hybrids could be obtained from forty pollinations attempted between them. Both varieties have 24 somatic chromosomes and exhibit similar cytological irregularities during meiosis (Mehra et al., 1961; Faruqi and Mehra, 1967). Binomial was a good fit to the distribution of multivalents during metaphase I of microsporogenesis in the var. *brevifolia*, indicating that all six groups of four chromosomes had an equal chance of pairing as a quadrivalent (Mehra et al., 1969). In the var. *nanella*, the binomial was not a good fit to the distribution of multivalents, indicating differential pairing behaviour of the chromosomes during metaphase I of microsporogenesis (Mehra et al., 1969). Thus, chromosomal differentiation seems to have taken place in the evolution of the var. *nanella*.

2. *S. brevifolia* var. *pulchella* Faruqi & Mehra, var. nov.

Caule ramoso, delicatulo, prostrato vel subascendente, 15-25 cm longo; folia lanceolata, elliptico-ovata, viridia, 5-6 cm longa, 1.5 cm lata.

HOLOTYPE: MEXICO: TAMAULIPAS, Cerro El Palmer S. of Cruillas, *Clover* 13763 (MICH). D.F. MEXICO: *Bartel* 13763 (MICH); *Clover* 14920; cultivated number and the name of the collector not given (MICH). U.S.A.: TEXAS: HIDALGO CO., *Lundell & Lundell* 9944 (US); *Cory* 20465 (GH); Corpus Christi, *Mcally* 1894 (GH).

Faruqi and Mehra (1966, 1967) reported that hybrids between varieties *brevifolia* and *nanella* resemble an undescribed taxon (now called var. *pulchella*) represented in living culture and herbarium specimens. While the types of chromosomal irregularities were similar in the parents and hybrids, the binomial was not a good fit to the distribution of multivalents in one of the three hybrids (Mehra et al., 1969). It would suggest differential pairing behaviour of chromosomes in this hybrid. The survival of such chromo-

some types with structural hybridity is enhanced owing to the vegetative mode of reproduction.

3. *S. brevifolia* var. *brevifolia*

Syn. *Tradescantia leiandra* var. *brevifolia*. Torr., in Emory U. S. and Mex. Bound. Survey 225. 1859.

Stem branched, prostrate or slightly ascending, about 30 cm long; leaves ovate, purple-green, 7-10 cm long and 2-3 cm wide.

HOLOTYPE: mountains near the mouth of the Pecos River, Oct. 19, 1852, *Bigelow* 1500 a (NY). MEXICO: Victoria, *Palmer* 601447 (F). U.S.A. TEXAS: Corpus Christi, *Rose* 1896 (GH), 839905 (GH); *Nealy*, 07.457 (F, GH, US); *Heller* 1427 (GH, MO, US); *Mulley* 1895 (US). CULTIVATED: *Norton* 1737019 (MO); *Rose*, July 21, 1896 (GH, US).

The type specimen is deposited in the N.Y. Botanical Garden Herbarium, but it is not in a condition that its floral morphology could be worked out. The type description mentions a pubescent ovary, but the sketch of the floral parts on the herbarium sheet shows glabrous ovary. Since there is no way to find out the actual position, the words from the description are taken as correct.

4. *S. brevifolia* var. *buckleyi* (Johnst.) Faruqi & Mehra, comb. nov.

Syn. *Tradescantia speciosa* Buckl., Proc. Acad. Phila. 1862: 9. 1863, non L.f. or H.B.K.

Setcreasea buckleyi Johnst., Jour. Arn. Arb. 25: 54. 1944.

HOLOTYPE: U.S.A. TEXAS, Corpus Christi, *Buckley*, number not given on the sheet (Acad. of Natural Sciences, Philadelphia). MEXICO: TAMAULIPAS, near Santa Terasa, *Johnston* 5491 (UT); north of Almada, *Johnston* 5707 B (UT); *Herman* 13763; New Victoria, collector not known (UT).

Johnston (1944) changed *Tradescantia speciosa* Buckl. to *S. buckleyi* and stated, "*S. brevifolia* is found from the Chisos and Davis Mts. to the lower Pecos River, and mor-

phologically it is a low plant with coarse rhizomes; whereas *S. buckleyi* is a plant of the coastal region of Texas which has a paler corolla and a loosely branched, elongated, trailing stem."

The only difference between this variety and var. *brevifolia* is its larger more or less elliptic leaves, 10-13 cm long and 2.8-4.2 cm wide; longer internodes and many branches from the base forming mounds in its natural habitat. Under greenhouse conditions, however, the plants usually referred to as *brevifolia* do possess leaves as big as var. *buckleyi* and it is very difficult to differentiate between these varieties (Faruqi and Mehra, 1966). The inland populations of var. *brevifolia* exhibit shortening of leaves towards its northern area of distribution as compared to the southern area. This, however, does not seem to be the case with coastal plants of var. *buckleyi* (Faruqi and Mehra, 1966). Under natural conditions var. *buckleyi* is certainly taller than var. *brevifolia*. Under greenhouse conditions it grows no taller than var. *brevifolia* and is slow growing and late flowering.

Under laboratory conditions varieties *brevifolia* and *buckleyi* could be crossed fairly easily and the seeds were produced when either one was used as the female parent. Thus, there is no genetic barrier between these varieties and the distinction between them is ecological and morphological. But, one specimen (*Johnston* 5491) from north Texas resembled var. *brevifolia* in a few characters and var. *buckleyi* in others, indicating some gene exchange between these varieties. Since these taxa demonstrate some degree of morphological differences and have different ecological preferences, they only deserve varietal status.

Mexico is the center of origin of the genus *Setcreasea*, and it is here that all of the primitive species such as *S. tumida* Rose, *S. australis* Rose, *S. purpurea* Boom and *S. pallida* Rose are distributed (Faruqi and Mehra, 1966). Primitive species of this genus have leaves larger than those of the advanced ones; by the same token a tendency towards the shortening of the shoot is also present in the advanced species. Thus, the leaves are larger and the stems are longer

in the populations of *S. brevifolia* distributed in the south (i.e., northern Mexico and southern Texas) than those in the populations distributed in the north (i.e., mid Texas). Thus, the var. *nanella* seems to have originated from *S. brevifolia* var. *brevifolia* in the process of its northward migration followed by ecological adaptation. It seems that in the origin of variations in *S. brevifolia* ecological adaptation has played an important role when migration from warm climate, where growing seasons are long, to cold climate, where the seasons for its growth are short, took place. An absence of this type of variation from south to north in the coastal population (var. *buckleyi*) seems to be correlated with the mild climate of the coastal areas. In fact, the leaves became longer and broader in the coastal area. Experimental hybrids between varieties *brevifolia* and *nanella* resembled var. *pulchella* and their leaf lengths were intermediate between those of their parents.

In *Setcreasea brevifolia*, the chromosome races with somatic chromosome numbers, 12 (Richardson, 1935), 23 (Celarier, 1955; Mehra et al., 1961), 24 (Darlington, 1929; Richardson, 1935, Mehra et al., 1961), 25 (Bose, 1962) and 36 (Anderson and Sax, 1936) have been reported. The materials of *S. brevifolia* used in this study had 23 (var. *brevifolia*) and 24 (vars. *nanella*, *pulchella* and *buckleyi*) somatic chromosomes. The previous reports on the chromosome morphology indicated that changes in the chromosome structure are taking place in this species (Darlington, 1929; Richardson, 1935). The chromosome and genetic differentiation is not uniform in all six sets of four chromosomes in the var. *nanella* (Mehra et al., 1969). It is assumed that *S. brevifolia* is in an active stage of evolution, in which euploidy, aneuploidy, structural hybridity, and hybridization between its varieties seem to be playing a major part. The vegetative mode of reproduction and perennial habit seem to be responsible for the maintenance of varieties within this species. Through the forces of selection some of these varieties are fixed in certain ecological niches, and wherever possible self-incompatibility ensures interpopula-

tion gene exchange through natural crossing. The range of morphological variation encountered is due to these factors, which in combination with each other produce an effect similar to that of facultative apomicts, exhibiting restricted gene exchange (Baker, 1953, 1959; Celarier et al., 1958; Faruqi, 1963; Faruqi and Mehra, 1968).

Thanks are extended to the curators of the Gray Herbarium of Harvard University, Cambridge; United States National Herbarium, Washington, D.C.; and herbaria of the Missouri Botanical Garden, St. Louis; New York Botanic Garden, N.Y.; Field Museum of Natural History, Chicago; Academy of Natural Sciences, Philadelphia; University of Texas, Austin; and University of Michigan, Ann Arbor, for the loan of the herbarium specimens. Thanks are also due to Rev. Fr. H. Santapau, for providing the Latin diagnosis for the new varieties, and to Mr. K. C. Kanodia, for discussions. The facilities of laboratory and greenhouse were extended by the courtesy of the late Dr. W. W. Hansen, Chairman, Dept. of Botany, Oklahoma State University, Stillwater, Oklahoma, for which the authors are highly grateful.

DEPARTMENT OF BOTANY AND PLANT PATHOLOGY
OKLAHOMA STATE UNIVERSITY
STILLWATER, OKLAHOMA 74074

LITERATURE CITED

ANDERSON, E. and K. SAX. 1936. A cytological monograph of the American species of *Tradescantia*. Bot. Gaz. **97**: 433-476.

BAKER, H. G. 1953. Race formation and reproductive method in flowering plants. Symp. Soc. Exptl. Biol. **7**: 114-143.

———. 1959. Reproductive methods as factors in speciation in flowering plants. Cold Spring Harb. Symp. **24**: 177-191.

BOSE, S. 1962. Cytotaxonomical studies in the genus *Setcreasea*. Bull. Bot. Surv. India **4**: 17-26.

CELARIER, R. P. 1955. Cytology of the Tradescanticae. Bull. Torrey Bot. Club. **82**: 30-38.

———, K. L. MEHRA and M. L. WOLF. 1958. Cytogeography of the *Dichanthium annulatum* complex. Brittonia **10**: 59-72.

DARLINGTON, C. D. 1929. Chromosome behaviour and structural hybridity in the Tradescantieae. Jour. Genet. **21**: 207-286.

FARUQI, S. A. 1963. The significance of apomixis in evolution and speciation of the Bothriochloininae. Biologia **9**: 57-64.

———— and K. L. MEHRA. 1966. A study of variation within *Setcreasea brevifolia* (Torr.) Sch. et Sydow and certain morphologically similar taxa. Rev. de Biol. **5**: 87-294.

———— and ————. 1967. Cytotaxonomical studies in the *Setcreasea brevifolia* complex. Cytologia **32**: 255-261.

———— and ————. 1968. Mode of reproduction and its bearing on the genetic diversity in the genus *Setcreasea*. Port. Acta Biol. (A.) 10: 321-326.

————, R. P. CELARIER and K. L. MEHRA. 1962. The taxonomy of *Setcreasea ovata*. Rhodora 64: 68-73.

JOHNSTON, I. M. 1944. Plants of Northern Mexico, III. Jour. Arnold Arb. **25**: 54.

MATUDA, E. 1955. Las Commelinaceas Mexicanas. Anal. Inst. Biol. Mex. **26**: 303-432.

MEHRA, K. L., S. A. FARUQI and R. P. CELARIER. 1961. A cytotaxonomical study of five species of *Setcreasea*. Phyton **17**: 133-140.

————, P. R. SREENATH and S. A. FARUQI. 1969. Distribution of multivalents and genotypic control of chromosome pairing in *Setcreasea* species and hybrids. Cytologia (in press).

RICHARDSON, M. M. 1935. *Setcreasea brevifolia*, a further example of polyploidy and structural hybridity in the Tradescantieae. Bot. Gaz. **97**: 400-407.

ROSE, J. N. 1899. *Treleasea*, A new genus of Commelinaceae. Contr. U. S. Nat. Herb. **5**: 207-208.

————. 1903. Studies of Mexican and Central American Plants No. 3. Contr. U. S. Nat. Herb. 8: 1-55.

————. 1911. Studies of Mexican and Central American Plants No. 7a. Contr. U. S. Nat. Herb. 13: 291-312.