

CHROMOSOME NUMBERS OF *TULIPA* SPECIES AND THE OCCURRENCE OF HEXAPLOIDY

G. H. KROON and M. C. JONGERIUS

Institute for Horticultural Plant Breeding (IVT), Wageningen, the Netherlands

Received 14 June 1984

INDEX WORDS

Tulipa, tulip, species, diploid, polyploid.

SUMMARY

Chromosome numbers of *Tulipa* species were determined. For the first time hexaploidy was found in the genus. It became clear that in many species or subspecies several ploidy levels may occur.

INTRODUCTION

For research on tulip breeding at IVT, as many wild *Tulipa* species as possible have been and are being collected. Species were obtained from private breeders and, more recently, also from original sources in Iran, Afghanistan and Turkey. To evaluate this collection, cytotaxonomic research was done. The chromosome numbers of some of these species are reported for the first time.

MATERIAL AND METHODS

In Table 1 the species name, the IVT code and the source of the material is given. Plants were grown in a glasshouse at 10°C. Root tips were pretreated with 60 ppm aqueous solution of IPC (isopropylphenyl-carbamate), a herbicide, and subsequently fixed in a 3:1 mixture of alcohol 96% and glacial acetic acid and stained with acetic orcein.

The herbarium of IVT contains pressed material of the plants of which the chromosome number was determined.

RESULTS AND DISCUSSION

The 80 introductions investigated involve 63 species representing 4 sections. Most (44) of the sources examined were diploid ($2n = 2x = 24$) and a relatively small number tetraploid (12), triploid (4) or pentaploid (2). One origin of *T. polychroma*, no. 71324, appeared to be hexaploid, which is the highest chromosome number so far determined in either wild species or garden varieties of the genus *Tulipa*.

The chromosome number determined in this material are given in Table 1. This table also includes the chromosome counts of BOTSCHANCEVA (1962), GABRIELIAN &

Table 1. Chromosome numbers of tulip species.

Species	IVT No.	Kroon	Others	Origin
<i>Section Eriostemones</i> BOISS.				
<i>T. aucheriana</i> BAKER	66242	24	24 ⁵	Van Tubergen, Haarlem
<i>T. australis</i> LINK	76121	24	24 ⁴	Elliott, Ashford
<i>T. bakeri</i> A. D. HALL	70604	24		Kooiman, Enkhuizen
<i>T. biebersteiniana</i> SCHULT.	67357	24	24 ¹	hortus Leningrad
<i>T. biebersteiniana</i> SCHULT.	68012	48		hortus Moscow
<i>T. biflora</i> PALL.	74227	24	24 ^{1,4}	Kooiman, Enkhuizen
<i>T. bifloriformis</i> VVED	65250	48	24, 36 ¹	hortus Leningrad
<i>T. bifloriformis</i> VVED	66090	48		hortus Leningrad
<i>T. celsiana</i> D.C.	65217	24		L.B.O., Lisse
<i>T. clusiana</i> D.C.	75306-B	48	60 ⁴	Kashmir, Jammu
<i>T. clusiana</i> D.C.	75306-A	60		Kashmir, Jammu
<i>T. clusiana</i> D.C. var.				
<i>chrysantha</i> (A. D. HALL)				
Sealy	71328	24	24, 48, 60 ³ 48 ⁴	Afghanistan, Ghazni
Sealy	71328	60		Afghanistan, Ghazni
	65218	48		L.B.O., Lisse
Sealy	66330	48		Van Tubergen, Haarlem
<i>T. clusiana</i> D.C. var.				
<i>stellata</i> (HOOK.) REGEL				
	66328	48	48 ⁴	Van Tubergen, Haarlem
<i>T. cretica</i> BOISS.	73155	24	24 ⁵	Crete, Akrotiri
<i>T. dasystemon</i> REGEL	68013	24	24, 48 ¹	hortus Moscow
<i>T. hageri</i> HELDR.	65473	24		Thoolen, Overveen
<i>T. humilis</i> HERB.	64172	24	24 ⁴	Van Tubergen, Haarlem
<i>T. neustrueva</i> POB.	77343	24	24 ¹	Uzbekistan
<i>T. orphanidea</i> BOISS. et HELDR.	64179	24	24 ⁴	Van Tubergen, Haarlem
<i>T. patens</i> AGARDH. ex SCHULT.	67330	48	24 ¹	hortus Copenhagen
<i>T. polychroma</i> STAFF.	71310	24	24 ^{2,5}	South-East Iran
<i>T. polychroma</i> STAFF.	71311	24		South-East Iran, Kuh-Taftan
<i>T. polychroma</i> STAFF.	76154	24		Iran, Shah-Dasht.
<i>T. polychroma</i> STAFF.	73113	48		Iran, Zagros mts.
<i>T. polychroma</i> STAFF.	71324	72		Afghanistan, Herat
<i>T. saxatilis</i> SIEB. ex SPRENGEL	64175	36		Van Tubergen, Haarlem
<i>T. sylvestris</i> L.	72106-B	48	48 ⁴	Iran, Hamadan
<i>T. tarda</i> STAFF.	67042	24	24, 48 ¹ , 24 ⁴	hortus Tashkent
<i>T. urumiensis</i> STAFF.	64177	24	24 ⁵	Van Tubergen, Haarlem
<i>T. whittallii</i> (DYKES) ELWES	64180	48	48 ⁴	Van Tubergen, Haarlem
<i>Section Leiostemones</i> BOISS.				
<i>T. acuminata</i> VAHL	67747	24		Thoolen, Overveen
<i>T. aitchisonii</i> A. D. HALL	71327	24		Afghanistan, Faizabad
var. <i>aitchisonii</i>	75307	24		Kashmir, Jammu
var. <i>aitchisonii</i>	71337	24		Afghanistan, Band-e-Amir
<i>T. aitchisonii</i> A. D. HALL				
var. <i>clusianoides</i> WENDELBO	71329	24		Afghanistan, Kabul
<i>T. albertii</i> REGEL.	68061	24		hortus Tashkent
<i>T. aleppensis</i> BOISS. ex. REGEL	77159	24	36 ⁵	Turkey, Antakya
<i>T. anadroma</i> Z. BOTSCH.	68068	24		hortus Tashkent
<i>T. anadroma</i> Z. BOTSCH.	76126	24		Elliott, Ashford
<i>T. armena</i> BOISS.	74223	24	24 ⁴	Van Tubergen, Haarlem
<i>T. banuensis</i> GREY-WILSON	71334	24		Afghanistan, Pul-e-Isar
<i>T. batalinii</i> REGEL	64181	24	24 ⁴	Van Tubergen, Haarlem

CHROMOSOME NUMBER OF TULIPA SPECIES

Species	IVT No.	Kroon	Others	Origin
<i>T. butkovii</i> Z. BOTSCH.	76124	24		Eliott, Ashford
<i>T. didieri</i> JORD.	66243	24		Van Tubergen, Haarlem
<i>T. ferganica</i> VVED.	76128	24		Eliott, Ashford
<i>T. greigii</i> REGEL	77291	24	24 ⁴	Western Tien Shan
<i>T. grengiolensis</i> THOMMEN	67738	24		Ruttier Lanche, Grenoble
<i>T. hungarica</i> BORB.	74197	24		Rumania, Danube valley
<i>T. karabachensis</i> GROSSH.	77161	24		Armenia, Shusha
<i>T. karabachensis</i> GROSSH.	77293	24		Armenia
<i>T. kolpakowskiana</i> REGEL	64183	24	24 ⁴	Van Tubergen, Haarlem
<i>T. kolpakowskiana</i> REGEL	68064	48		hortus Tashkent
<i>T. lanata</i> REGEL	65369	36	36 ^{1,5}	Van Tubergen, Haarlem
<i>T. linifolia</i> REGEL	70596	24	24 ⁴	Kooiman, Enkhuizen
<i>T. linifolia</i> REGEL	70662	24		Kooiman, Enkhuizen
<i>T. marjoletti</i> PERR. et SONG	65299	24		Inst. hort. Pruhonice
<i>T. micheliana</i> HOOG	71315	24	24 ⁵	Iran, Birjand
<i>T. montana</i> LINDL.	76156	24	24 ²	Iran, Moraveh Teppéh
<i>T. montana</i> LINDL. yellow form	73116	24	24 + 2B ²	Iran, Elbruz mts.
<i>T. ostromskiana</i> REGEL	65380	48	24 ⁵	Van Tubergen, Haarlem
<i>T. planifolia</i> JORD.	67737	24	24 ⁵	Ruttier Lanche, Grenoble
<i>T. praecox</i> TENORE	77101	36		Korcula, Donje Blato
<i>T. schrenkii</i> REGEL	65150	24	24 ²	Van Eeden, Noordwijk
<i>T. scardica</i> BORNM.	75107	24		hortus Skopje
<i>T. stapfii</i> TURRILL	71340-A	24	24 ⁵	Iran, Gulestan Forest
<i>T. systola</i> STAPF	76155	24		Iran, Moraveh Teppéh
<i>T. tetraphylla</i> REGEL	68040	48	24, 48 ¹	hortus Stockholm
<i>T. ulophylla</i> WENDELBO	77164	24		Wendelbo, Göteborg
<i>T. vvdensky</i> Z. BOTSCH	77298	36		Western Tien Shan
<i>T. vvdensky</i> Z. BOTSCH	76127	24		Eliott, Ashford
<i>T. zenaidae</i> VVED.	77299	24		Kirgizkiy, Alatau
<i>Section Tulipanum</i> REB.				
<i>T. julia</i> K. KOCH	68075	24	24 ²	hortus Tashkent
<i>T. julia</i> K. KOCH	72119	24		Armenia, Erevan
<i>T. kuschkensis</i> B. FEDTSCH.	71320	24	24 ^{1,5}	Afghanistan, Herat
<i>T. tubergeniana</i> HOOG	65391	24	24 ^{1,5}	Van Tubergen, Haarlem
<i>Section Spiranthera</i> VVED.				
<i>T. kaufmanniana</i> REGEL	77294	24		Western Tien Shan
<i>T. tschimganica</i> Z. BOTSCH.	76123	24		Elliott, Ashford

¹ BOTSCHANCEVA (1962)

² GABRIELJAN & POGOSJAN (1971).

³ HALL (1937).

⁴ NEWTON (1927).

⁵ UPCOTT & LA COUR (1936).

POGOSJAN (1971), HALL (1937), UPCOTT & LA COUR (1936) and NEWTON (1927).

For the greater part the chromosome numbers agreed with those reported in former cytotaxonomic research, but some deviations were found. In the section Eriostemones, *T. biebersteiniana* showed two ploidy levels: no. 67357 being diploid and no. 68012 tetraploid. Two origins of *T. bifloriformis* appeared to be tetraploid, whereas earlier counts of NEWTON (1927) and BOTSCHANCEVA (1962) only showed diploid and triploid forms of this species. In *T. chusiana*, earlier determined as a pentaploid (NEWTON, 1927), both a tetraploid and a pentaploid type were found and in *T. chusiana* var. *chrysantha* diploid, tetraploid and pentaploid forms were observed, which was also done by others. *T. patens* was tetraploid, whereas BOTSCHANCEVA (1962) discovered that this species was a diploid. Earlier reports stated that *T. polychroma* was a diploid (UPCOTT & LA COUR, 1936; GABRIELJAN & POGOSJAN, 1971), but our material included tetraploid and hexaploid forms as well.

In the section Leiostemones, the species *T. kolpakowskiana* and *T. ostrowskiana* appeared to include tetraploid forms not reported before. Our introduction of *T. alepensis* was found to be diploid; HALL (1937) determined this species as a triploid.

From this research, together with the results of other authors, it becomes clear that in many *Tulipa* species or subspecies several ploidy levels may occur. As can be seen in Table 1, out of a total of 63 species 13 were found to occur at different ploidy levels.

REFERENCES

- BOTSCHANCEVA, Z. P., 1962 Tulips (Morphology, cytology and biology). Tashkent.
 GABRIELJAN, E. C. & A. I. POGOSJAN, 1971. Taxonomic and karyologic investigations of Armenian tulips. Iz. Akad. Nauk. Arm. SSR 24(5): 51-60.
 HALL, A. D., 1937. Polyploidy in *Tulipa*. J. Linn. Soc. Bot. 50: 481-489
 NEWTON, W. C. F., 1927. Chromosome studies in *Tulipa* and some related genera. J. Linn. Soc. Bot. 47: 339-354.
 UPCOTT, M. & L. LA COUR, 1936. The genetic structure of *Tulipa* I, a chromosome survey. J. Genet. 33(2): 237-254.