Some New Records of Chromosome Numbers in Iranian Charophytes

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Abstract

Chara is an interesting genus from cytological view has been extensively worked out in Europe and North America, but there is a few reports on Asian Charophytes. Chromosome number were determined for 10 species of *Chara* from 33 populations. Chromosome counts were as follows: *C. connivens*, n=14, *C. contraria*, n= 28; *C. crassicaulis*, n=21; *Chara gymnophylla* var. *gymnophylla*, n=14; *Chara gymnophylla* var. *rohlenae*, n=14; *C. kirghisorum*, n=14; *C. kohrangiana*, n=21, *C. socotrensioides*, n=14; *C. tomentosa*, n=14; *Chara vulgaris* var. *longibracteata*, n=28 and *Chara vulgaris* var. *vulgaris*, n=28. Authors made cytological studies of Iranian charophytes in twelve taxa which 10 taxa are new for Iran and five taxa are new for science.

Keywords: Chromosome number, *Chara,* Charophytes, Iran.

Introduction

Cytological investigation of chromosome number in Characeae have been made in the last several decades and reported distinct chromosome number within different genus of Characeae (Hotchkiss, 1958 and 1963; Gillet, 1959; Corillion and Guerlesquin, 1959 and 1961; Imahori and Kato, 1964). Nagl and Furening (1979) have been reported that the chromosome number of algae are like to the higher plants, and posses localized centromers. Gillet (1956) suggested 7 base chromosome number in *Chara* and 6 base chromosome number for *Nitella* and 14 or possibility 7 base chromosome number for *Chara.* Ramjee and Sarma (1971) showed that there is 34% polypoloidy within different species of *Chara*. Polypoloidy is common mechanism for speciation and intraspecific barrier to gene flow in the genus *Chara* (Williams and Tindal, 1975). Several studies on *Chara* species showed that polypoloidy in dioecious species is more common than monoecious species (Grant and Proctor, 1972; Corillion and Guerlesquin, 1972; Guerlsquin 1967).

Study of the chromosome number in Characeae is useful tool for taxonomic problems (John et al., 1975). Several authors have been reported chromosome number of Characeae from India and Pakistan (Noor, 1969; Noor and Mukherjee, 1977; Khan and Sarma, 1967; Sinha and Verma, 1970), but there are a few works that have been done on Iranian Characeae (Sheidai et al., 1995). In the present study chromosome numbers have been reported in ten taxa belonging to the genus *Chara* L. which is new for Characeae.

Materials and Methods

Living speciemens were collected in June,

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July and August 2009 from different localities, then plants with Antheridia were kept in glass beakers in soil water medium. The specimens were identified with the matrix keys for *Chara* and *Nitella* (Van Raam and Stewart, 2009) and with the figures in Han and Li (1994), Krause (1997), Pal et al. (1962), Wood and Imahori (1964). Taxon names are in accordance with the names in Algaebase web site (www.algaebase.org) and the Synopsis of the Characeae (Van Raam and Stewart, 2009). Voucher mounted specimens were deposited in the Herbarium of Shahid Beheshti University (HSBU) and there is a list of localities in appendix table. *Chara connivens* Salzmann ex A. Braun, *Chara contraria* A. Braun ex Kützing, *Chara crassicaulis* Schleicher, *Chara gymnophylla* (A. Braun) A. Braun var. *gymnophylla*, *Chara gymnophylla* var. *rohlenae* (Vilhelm) Filarszky, *Chara kirghisorum* Lessing, *Chara pedunculata* Kützing, *Chara socotrensioides* R. D. Wood and *Chara kohrangia*., *Chara vulgaris* var. *longibracteata* (Kützing) J. Groves and Bullock-Webster, *Chara vulgaris* Linnaeus var. *vulgaris* and *C. tomentosa* Linnaeus. Branchlets with developing antheridia were removed and fixed in absolute ethanol and glacial acetic acid and aceto-carmine or aceto-orcein squashing method was used for chromosome preparations. Five to ten methaphase cells have been counted for chromosome number.

Results

In most of prophase cells there was clumping between chromosomes and produce a compact mass of chromosome or in some cells there is number of chromosome masses. Chromosome number of investigated species are included in Table 1 and Figures 1-12.

Table 1. Species of Characeae and their chromosome numbers.

Name of the taxa	Sexuality	Chromosome number (n=)	Section	Subsection	Figure
C. connivens	dioecious	n=2x=14	*Grovesia*		1
C. contraria	monoccious	n=4x=28	*Chara*		2
C. crassicaulis	monoecious	n=3x=21	*Chara*		3
Chara gymnophylla	monoccious	n=2x=14	*Chara*		4
Chara gymnophylla var. *rohlen* ((Vilhelm) Ahmadi in Ahmadi et al. 201	monoccious	n=2x=14	*Chara*		5
C. kirghisorum	dioecious	n=2x=14	*Chara*		6
C. kohrangiana Ahmadi 2012	monoccious	n=3x=21	*Chara*	Charopsis	7
C. pedunculata Kützing	monoccious	n=5x=35	*Chara*	Hartmania	8
C. socotrensioides	monoecious	n=2x=14	*Chara*		9
C. tomentosa	dioccious	n=2x=14	*Chara*		10
Chara vulgaris var. *longibracteata*	monoecious	n=4x=28	*Chara*		11
Chara vulgaris var. *vulgaris*	monoccious	n=4x=28	*Chara*		12

In most of the metaphase cells in *C. connivens* chromosome number was n=14 (Fig. 1). In *C. contraria* it was n=28 (Fig. 2). Mitotic cells in *C. crassicaulis* showed chromosome number n=21 (Fig. 3).

In *C. gymnophylla* two populations have been observed which were separated as *C. gymnophylla* var. *gymnophylla* and *C. gymnophylla* var. *rohlenae*, A chromosome number of 14 was observed for two varieties but there was some variations in chromosome number n=7, 21 for these two varieties (Figs 4, 5). In *C. kirghisorum* chromosome counts was obtained n=14 (Fig. 6). Our counts on chromosomes in antheridial cells for *C. kohrangiana* were n=21 (Fig. 7) . *C. pedunculata* chromosome number counts was n=35 (Fig. 8). *C. socotrensioides* chromosome counts was n=4 (Fig. 9). Chromosome number in *C. tomentosa* were obtained as n=14 (Fig. 10). Chromosome number in two varieties of *C. vulgaris* var. *longibracteata* and *C. vulgaris* var. *vulgaris* were n=28 (. 11, 12).

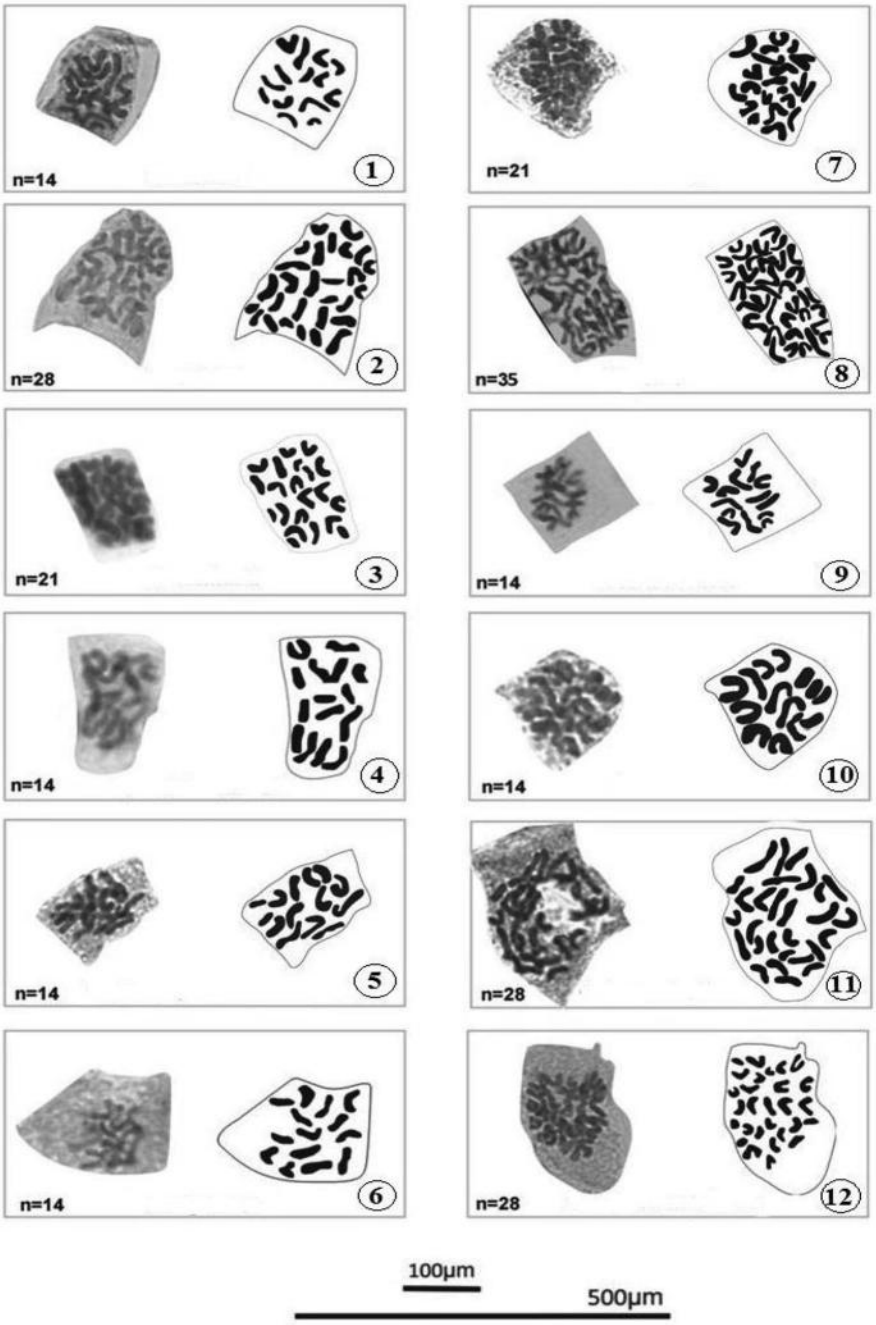
Discussion

The present finding support base chromosome number n=7 as ancestral basic chromosome number for the genus *Chara*. Kasaki (1964) proposed reduction theory of evolution in base chromosome number. Sarma et al. (1970), Sawa (1974) and Bhatnagar (1983) discussed on evolutionary sequences and interrelationships of Charophytes based on cytological findings. Sawa (1974) realised that ancestral forms of Charophyta possess x=3.

Antheridial spermatogenesis cells in Characeae have synchronous nucleous division, it helps to see easily metaphase chromosomes. There was chromosomes mass because of clumping in prophase cells and it may be happen because of homologues between repeated chromosomes. Grant and Proctor (1972) showed Chromosome number interspecific variation. They reported different chromosome number in *C. contraria* n=14, 28, 42. Grant and proctor (1970) have been studied cytotypes in *C. contraria* and found three different chromosome number (n= 14, 28, 42). Williams and Tindall (1975) reported n=42 for *C. contraria* and we found n=28. Our counts of *C. vulgaris* n=28 but Grant and Proctor (1972) reported n=14, 28, 42, John et al. (1975) determined n=42 for this species and Maszewski and Kolodziejzyk (1991) determined n=28. Noor and Mukherjee (1977) reported chromosome number in *C. vulgaris* var. *vulgaris* f. *artrovirens* n=35. *C. crassicaulisis* morphologically similar to *C. vulgaris* and we found n=21 in this species. Subrahmanyam and Chowdary (1992) reported chromosome counts in *Chara vulgaris* var. *gymnophylla* f. *grovesi* in=35 but our counts for two varieties of *C. gymnophylla* var. *gymnophylla* and *C. gymnophylla* var. rohlenaewere n=14,It was the first report for twovarieties of *C. gymnophylla*.

C. kirghisorum is also first report of chromosome numbern=14, in the point of taxonomic view it is similar to *C. vulgaris* but this species is dioecious. *C. kohrangiana* is a new species belongs to the genus *Chara* subgenus *Charopsis* section *Agardhia* subsection *Agardhia* (Ahmadi et al., 2012. under publication) and chromosome number was n=21. Chromosome counts in *C. pedunculata* is n=35. *C. socotrensioides* chromosome number is n=14 and it has not been reported before for this species. We counted chromosome number for *C. tomentosa* n=14, Kunachowicz et al. (2001) reported

n=14. Bhatnagar (1988) suggested that haplostephanous forms of *Chara* (subgenus: Charopsis) are primitive than the diplostephanous forms of *Chara* (subgenus: *Chara*). In this study most of dioecious species are diploid but monoecious species have different polypoloidy level (n=2x, 3x, 4x, 5x).



Figs. 1-12. Chromosome morphology in species of *Chara*: 1. *C. connivens*,2. *C. contraria*, 3. *C. crassicaulis*,4. *C.gymnophylla*var. *gymnophylla*, 5. *C. gymnophylla*var. *rohlenae,* 6. *C. kirghisorum*, 7. *C. kohrangiana*, 8. *C. pedunculata,* 9. *C. socotrensioides*, 10. *C. tomentosa*, 11. *C. vulgaris* var. *longibracteata*, 12. *C. vulgaris* var. *vulgaris*

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Table 2: Details of the localities.

C. connivens
Isfahan Province
31°12'36" N 51°40'12" E 2360 HSBU-8800320; 10.06.2009
C. contraria
Markazi province
39°48′40″N, 37°06′08″E 2275 HSBU-8800863; 3.04.2009
35°30′40″N, 37°55′25″E 1995 HSBU-8808610; 20.04.2009
35°36′25″N, 37°40′37″E 2200 HSBU-8808613; 29.03.2009
Fars province
30°25′05″N, 53°25′46″E 2375 HSBU-8800715; 12.05.2009
East Azarbaijan
36°36′13″N, 47°14′06″E 2202 HSBU-8800448; 26.06.2009
C. crassicaulis
Qom Province:
34°23′22″N, 50°51′41″E 1468 HSBU-8800251; 6.06.2009
Chara gymnophylla var. ***gymnophylla***
Fras province
30°27'37" N 51°47'22" E 2143 HSBU-8808719; 25.08.2009
Markazi province
39°13'84" N 38°98'15" E 2100 HSBU-8808627; 10.06.2009
34°87'96" N 37°81'28" E 1800 HSBU-8808611; 29.05.2009
34°80'96" N 37°71'76" E 1900 HSBU-8808614; 29.05.2009
Ardebil Province
38°32'07" N 47°53'55" E 1076 HSBU-8800451; 28.08.2009
East Azarbaijan
37°21'13" N 45°09'18" E 1334 HSBU-8800444; 26.08.2009
Chara gymnophylla var. ***rohlenae***
Fras province
30°37'36" N 53°10'41" E 2313 HSBU-8800711; 25.08.2009
Markazi province
34°80'96" N 37°71'76" E 1900 HSBU-8808614; 29.05.2009
Chaharmahal and Bakhtiari Province
32°17'24" N 50°38'52" E 2059 HSBU-8800381; 15.08.2009
Kohkiliyo and BoyerahmadProvice
30°51'56" N 51°20'06" E 1542 HSBU-8800741; 14.08.2009
Isfahan Province
32°47'07" N 51°01'50" E 1979 HSBU-8800313; 9.08.2009
C. kirghisorum
Markazi province
33°73'68" N 37°38'98" E 2034 HSBU-8808616; 31.07.2009
Chara kohrangiana
Chaharmahal and Bakhtiari Province
32°22'15" N 50°26'03" E 2324 HSBU-8800383; 15.06.2009
C. socotrensioides
Chaharmahal and Bakhtiari Province
31°51′35″ N 51°19′59″ E 1552 HSBU-8800742; 14.06.2009
C. pedunculata
IsfahanProvince
31°12'36" N 51°45'12" E 2360 HSBU-8800321; 10.06.2009
C. tomentosa
Isfahan Province
32°47'07" N 51°01'50" E 1979 HSBU-8800312; 06.08.2009
31°12'36" N 51°45'12" E 2360 HSBU-8800319; 10.06.2009
Chara vulgaris **var.** ***longibracteata***
Markazi province
39°87'23" N 38°28'31" E 2105 HSBU-8800864; 10.06.2009
33°84'34" N 37°99'36" E 1800 HSBU-8808615; 31.07.2009
34°36'20" N 50°21'21" E 1446 HSBU-8808619; 10.06.2009
Isfahan Province
33°57'56" N 51°15'03" E 1994 HSBU-8800311; 07.06.2009
Fars province
30°20'35" N 53°53'40" E 1891 HSBU-8800714;12.06.2009
Chara vulgaris **var.** ***vulgaris***
Markazi province
39°05'52" N 38°24'71" E 1943 HSBU-8800865; 10.06.2009
35°30'40" N 37°55'25" E 1995 HSBU-8800869; 20.07.2009
East Azarbaijan Province
37°27'45" N 44°55'32" E 1521 HSBU-8800445; 26.08.2009
Lorestan province
36°30'91" N 37°49'09" E 2000 HSBU-8800661; 20.08.2009
Qom Province
34°21'10" N 50°54'19" E 1600 HSBU-8800254; 06.08.2009