

Cytological study of *Medicago* species in Iran

(:)

(n =)

(n =)

M. sativa

M. ciliaris

M. scutellata M. rugosa

M. minima M. lupulina M. radiata

M. turbinata M. noeana M. orbicularis M. tornata M. sauvagei M. laciniata M. coronata

M. aculeata M. arabica M. littoralis M. truncatula

M. rigiduloides M. rigidula M. polymorpha M. constricta

M. ciliaris

: سطح پلوئیدی، سیتوزنتیک، کروموزوم، یونجه، دیپلوئید، تتراپلوئید.

(Shariat, 2001)

M. radiata *M. polymorpha*

M. scutellata

M. littoralis *M. truncatula* *M. radiata* *M. minima*

M. rigidula *M. orbicularis*

.(Sheidai and Shafeineya, 2001)

Medicago

.(Small and Jomphe, 1988)

(Karadag and Gulcan, 1997)

M. polymorpha *M. orbicularis* *M. scutellata*

n = n = n =

M. scutellata

M. polymorpha

(Lemmi *et al.*, 1995)

(Mariani and Falistocco,

n = x = n = x = 1990)

C- *M. murex*

Banding

n = n =

(Mariani and Falistoco, 1991)

(Mariani *et al.*, 1996)

(Shariat, 2001)

(Mousapour Gorgie, 1998)

(Gazanchian, 1993)

(Sheidai and Shafeineya, 2001)

(Lemmi *et al.*, 1995)

(Micromerasure)

M. orbicularis *M. littoralis* *M. radiata*
M. noeana *M. sativa* *M. polymorpha* *M. rugosa*
M. turbinata *M. constricta* *M. minima*
M. aculeata *M. rigidula* *M. rigiduloides*
M. sauvagei *M. laciniata* *M. truncatula*
M. lupulina *M. scutellata* *M. arabica*
M. tornata *M. ciliaris* *M. coronata*

()

M. rugosa

M. sativa

()

(Levan *et al.*, 1964)

()

(%)

(Metacentric)

(Sub-metacentric)

M. lupulina

M. sativa

Medicago

Table 1. The studied *Medicago* populations and their habitats in Iran.

Row	Species	Collection site
1	<i>M. radiata</i>	Fars: Sepidan, Cheshme Shol, 2110m
2	<i>M. radiata</i>	Lorestan: Aleshtar, Raimaleh, 1500 m
3	<i>M. radiata</i>	Lorestan: Khoramabad, Tange Daredozdan, Deh.e.Pir, 1620m
4	<i>M. radiata</i>	West Azarbaijan: Piranshahr, Mirabad, 1440m
5	<i>M. littoralis</i>	Golestan, Gonbad, Besh Ailan Valley, 140m,
6	<i>M. orbicularis</i>	Fars: Kazerun, Kotal Pirzan, 1300m
7	<i>M. orbicularis</i>	Kermanshah: Biston, Najivaran, 1420m
8	<i>M. orbicularis</i>	Kermanshah: Kerend Gharb, Sorkhe Dizeh, 1420m
9	<i>M. rugosa</i>	Khuzestan: Ahvaz, 80m
10	<i>M. polymorpha</i>	West Azarbaijan: Piranshahr, Mirabad, 1440m
11	<i>M. polymorpha</i>	West Azarbaijan: Sardasht, 1200m
12	<i>M. polymorpha</i>	Kermanshah: Sarpole Zahab, Sarabe Garm, 100m
13	<i>M. sativa</i>	Golestan: Chahar Bagh, 800m
14	<i>M. sativa</i>	East Azarbaijan: Tabriz, 1400m
15	<i>M. noeana</i>	Lorestan: Aleshtar, Raimaleh, 1500m
16	<i>M. noeana</i>	West Azarbaijan: Mahabad, Shahindaj, Aghjavan, 1500m
17	<i>M. minima</i>	Qazvin: Alamut, Moalem Kelayeh, 1630m
18	<i>M. minima</i>	East Azarbaijan: Kalibar, Joshun, 1250m
19	<i>M. constricta</i>	Kermanshah: Sarpole Zahab, Sarabe Garm, 700m
20	<i>M. turbinata</i>	Kermanshah: Sarpole Zahab, Sarabe Garm, 700m
21	<i>M. turbinata</i>	Fars: Chenar Shahijan, Ganji, 810m
22	<i>M. rigiduloides</i>	Fars: Sepidan, Cheshmeh Shol, 2110m

Table 1. Continued

	Species	Collection site
23	<i>M. rigiduloides</i>	Kermanshah: Eslam Abad Gharb, Tarazak Abdoloh, 1500m
24	<i>M. rigiduloides</i>	East Azarbaijan: Kalibar, Ahar, Janbag, 1620m
25	<i>M. rigidula</i>	West Azarbaijan: Mahabad, Ashkan, 1320m
26	<i>M. aculeata</i>	Kermanshah: Sarpole Zahab, Sarabe Garm, 700m
27	<i>M. laciniata</i>	Fars: Parishan Lake, Nooshinjan, 970m
28	<i>M. sauvagei</i>	Khuzestan: Shooshtar, 140m
29	<i>M. arabica</i>	Golestan: Agh Ghola, Marzan kalateh, 80m
30	<i>M. arabica</i>	Golestan: Gorgan, Toskasthan, 860m
31	<i>M. scutellata</i>	Bushehr: Dashtestan, Tange Zard, 460m
32	<i>M. lupulina</i>	West Azarbaijan: Takab, Takhte Soleiman, 2200m
33	<i>M. coronata</i>	Fars: Kazerun, Kotale Pirzan, 1700m
34	<i>M. coronata</i>	Qazvin: Alamut Razmian, 1060m
35	<i>M. ciliaris</i>	Khuzestan: Behbahan, Maroon, 300m
36	<i>M. tornata</i>	Kermanshah: Biston, Najivaran, 1420m

(Bauchan and Elgin, 1984)

M. ciliaris

(A B)

(C)

(Heyn, 1963)

M. rugosa

(A) *M. scutellata*

M. scutellata

M. radiata

M. noeana *M. orbicularis* (D)

M. truncatula *M. turbinata* *M. minima*

n = n =

Table 2. Karyotypic characterization of Medicago species

Species	(n) Ploidy level (2n)	() Mean of chromosome length (µm)	Karyotypic Formula	Satellite
<i>M. radiata</i>	16	2.10	6 m† + 2 sm‡	
<i>M. littoralis</i>	16	1.73	5 m + 3 sm	2
<i>M. orbicularis</i>	16	2.60	7 m + 0 sm	
<i>M. rugosa</i>	30	1.05	14 m + 0 sm	
<i>M. polymorpha</i>	14	2.30	6 m + 0 sm	
<i>M. noeana</i>	16	1.40	7 m + 0 sm	
<i>M. minima</i>	16	1.10	6 m + 2 sm	2
<i>M. constricta</i>	14	1.90	4 m + 3 sm	
<i>M. turbinata</i>	16	1.34	7 m + 0 sm	
<i>M. truncatula</i>	16	1.60	6 m + 2 sm	
<i>M. rigiduloides</i>	14	1.82	6 m + 0 sm	2
<i>M. rigidula</i>	14	2.10	6 m + 0 sm	
<i>M. aculeata</i>	16	1.70	7 m + 0 sm	
<i>M. laciniata</i>	16	1.80	3 m + 5 sm	
<i>M. sauvagei</i>	16	1.50	6 m + 2 sm	
<i>M. arabica</i>	16	1.30	4 m + 4 sm	2
<i>M. tornata</i>	16	1.12	5 m + 3 sm	2
<i>M. lupulina</i>	16	1.43	5 m + 3 sm	
<i>M. sctellata</i>	30	1.86	8 m + 0 sm	2
<i>M. coronata</i>	16	1.20	7 m + 0 sm	
<i>M. ciliaris</i>	18	1.72	7 m + 2 sm	
<i>M. sativa</i>	32	2.90	14 m + 2 sm	4
<i>M. sativa</i>	16	2.80	7 m + 0 sm	2

† Metacentric and ‡ Sub-metacentric

‡ †



(B) n = (A) n = (*Medicago sativa* L.)

Fig 1. Karyotype of two *Medicago* (*Medicago sativa* L.) populations; 2n = 32 (A) and 2n = 16 (B).

M. polymorpha () *M. sauvagei* *M. laciniata* *M. aculeata*
M. rigiduloides (C) *M. rigidula* *M. coronata* *M. lupulina* *M. arabica*
tornata

M. rigidula *M. polymorpha* *M. murex*
M. muricoleptis

M. onstricta

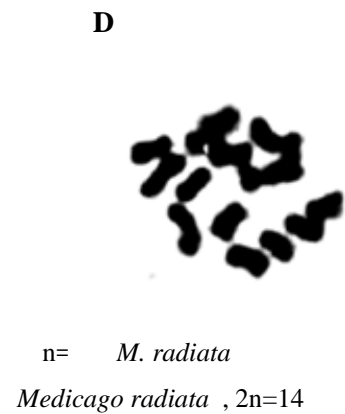
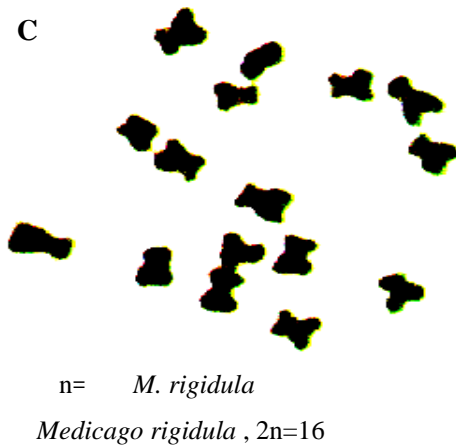
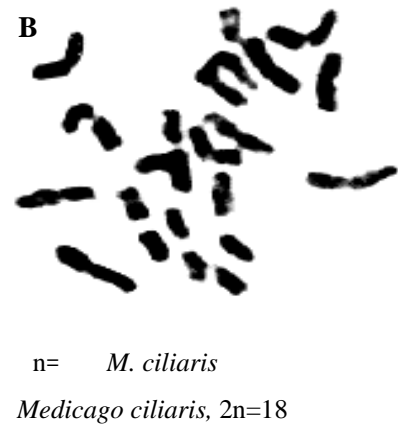
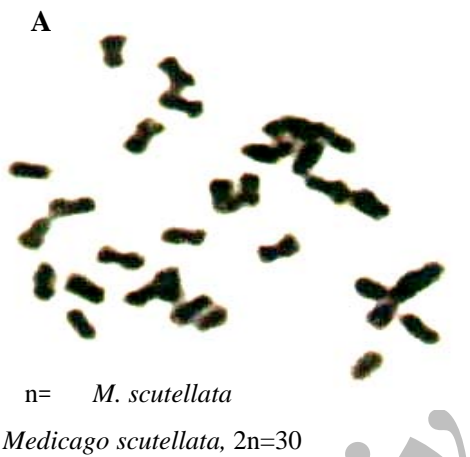
n =

(Falistocco and Falcinelli, 1991)

(Mariani *et al.*, 1996)

M. rigidula *M. polymorpha* *M. murex*

M. intertexta



(B) *M. ciliaris* (A) *M. scutellata*

(D) *M. radiata* (C) *M. rigidula*

Fig 2. Karyotype of four annual medicago species during metaphase mitosis including *M. scutellata* (A), *M. ciliaris* (B), *M. rigidula* (C) *M. radiata* (D) with 30, 18, 16 and 14 chromosomes, respectively.

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M. rigiduloides

.(Small, 1990) *M. rigiduloides* *M. minima* *M. littoralis*

M. rigidula *M. sativa* *M. tornata* *M. arabica*

M. scutellata

M. sativa

M. tornata

M. littoralis

(Small and Jomphe, 1988)

M. rigidula

M. rigiduloides

M. rigidula

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Cytological study of *Medicago* species in Iran

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ABSTRACT

Ghanavati, F. and J. Mozaffari. 2008. Cytological study of *Medicago* species in Iran. *Iranian Journal of Crop Sciences*. 10(2): 136-145.

Thirty six *Medicago* populations were collected from natural habitats across Iran. Number and size of chromosomes as well as karyotypic formula of the populations were measured and studied using their root tip meristems. This study showed that *M. sativa* consists of diploid ($2n = 16$) and tetraploid ($2n = 32$) populations in Iran, while *M. rugosa* and *M. scutellata* were tetraploid ($2n = 30$) and *M. ciliaris* was diploid ($2n = 18$). In addition, *M. radiata*, *M. lupulina*, *M. minima*, *M. coronata*, *M. laciniata*, *M. saugei*, *M. tornata*, *M. orbicularis*, *M. noeana*, *M. turbinata*, *M. truncatula*, *M. littoralis*, *M. arabica* and *M. aculeata* were diploid possessing 16 chromosomes, while *M. constricta*, *M. polymorpha*, *M. rigidula* and *M. rigiduloides* were diploid possessing 14 chromosomes. Based on karyotypic formula, in these species most of the studied chromosomes were metacentric and sub-metacentric. This study also revealed that *M. ciliaris* has genotypes with $n = 9$ base chromosomes in Iran.

Key words: Chromosome, Cytogenetic, *Medicago*, Ploidy levels, Diploid, Tetraploid

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