

NOTES ON THE GENUS ASTRAGALUS IN IRAN IV, CYTOTAXONOMIC STUDIES ON SOME SPECIES

(Dedicated to Prof. Dr. E. Esfandiari on the occasion of his 80th birthday).

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Chromosome counts of 34 taxa belong to the genus *Astragalus* are recorded. More to a table which is showing chromosome number and previous chromosomic counts of the taxa, karyotype morphology of some relatives are briefly discussed. Figures of the karyotype of some taxa are given.

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مطالعاتی در باره جنس گون (*Astragalus*) در ایران (۴)، سیتوتاگزونومی
تعدادی از گونه‌ها .
از: علی اصغر معصومی

شمارش کروموزومی ۳۴ واحد رده‌بندی از جنس گون (*Astragalus*) گزارش داده می‌شود. در یک جدول تعداد کروموزوم گونه‌های مطالعه شده و همچنین مراجع مربوط به مطالعات انجام شده در جدول نشان داده می‌شود. شکل ظاهری کاربوتیپ و گونه‌های خویشاوند مورد بحث واقع شده و تصاویر کاربوتیپ تعدادی از گونه‌ها ارائه می‌گردد.

INTRODUCTION

In the course of a cytotaxonomic study on the genus *Astragalus* 36 taxa belong to 8 sections from different regions of Iran were examined. In this study 33 chromosomal counts are recorded for the first time, they are marked by an asterisk. Some endemic species with their closest relatives karyologically were discussed. All voucher specimens are deposited in the herbarium of Research Institute of Forests and Rangelands (TARI).

Materials and Methods

Chromosome counts were based on root tips grown by seeds which have been taken from the herbarium specimens and floret buds, collected in the different parts of Iran in the botanical excursions. Root tips were fixed in fixative (3:1 absolute ethanol/ glacial acetic acid), hydrolized and stained by using Feulgen method; floret buds were fixed with the same fixative in the field, stored in refrigerator and stained in a mixture of

Table 1. Karyologically studied *Astragalus* species, chromosome number and previous record (*new records)

Name	n, 2n=	Previous records
* <i>A. aegobromus</i>	n=8	
* <i>A. angustiflorus</i> ssp. <i>angustiflorus</i>	2n=16	
* <i>A. avicennus</i>	n=8	
* <i>A. basilicus</i> (type specimen)	n=8	
* <i>A. brachystachys</i>	2n=16	
* <i>A. callainus</i> (type specimens)	n=8	
* <i>A. caryolobus</i>	2n=16	
* <i>A. citrinus</i> ssp. <i>barrowianus</i>	n=8	n=8 (Maassoumi 1987)
* <i>A. deickianus</i>	n=8	
* <i>A. eriopodus</i>	n=13	
* <i>A. hohenackeri</i>	n=8	
* <i>A. ibicinus</i>	n=8	
* <i>A. inquilinus</i> (type specimen)	n=8	
* <i>A. kirpicznikovii</i>	2n=16	

* <i>A. lambinoni</i>	2n=24	
* <i>A. maymanensis</i>	n=8	
* <i>A. monanthemus</i>	2n=14+B	
* <i>A. multijugus</i>	n=8	
* <i>A. ovinus</i>	n=8	
* <i>A. pellitus</i>	n=8, 2n=16	
* <i>A. pinetorum</i> Boiss. ssp. <i>pinetorum</i>	n=8	
*— <i>declinatus</i>	n=8	
* <i>A. piranshahricus</i> (paratype specimen)	2n=16	
* <i>A. pseudoindurascens</i>	2n=16	
* <i>A. pseudovinus</i>	n=8	
* <i>A. remotijugus</i>	n=8, 2n=16	n=8, 2n=16 (Maassoumi 1987)
* <i>A. rimarum</i>	2n=16	
* <i>A. semilunatus</i>	2n=16	
* <i>A. siliquosus</i> ssp. <i>siliquosus</i>	n=8	n=8 (Maassoumi 1987)
* <i>A. sp.</i>	n=8	
* <i>A. tawlicus</i>	n=8	
* <i>A. urmiensis</i>	2n=16	
* <i>A. vereskensis</i>	n=8	
* <i>A. volcanicus</i>	n=8	

simple aceto-carmin and ferric aceto-carmin. For some species pretreatment of colchicine (0.05%) were used.

DISCUSSION

Sect. *Astragalus*

Astragalus caryolobus Bge. (2n = 16, Fig. 1). — Kordestan: 9 km from Mahabad to Sardasht, 1700 m, 6.7.1974, Babakhanlou 31022.

Sect. *Caprini* DC.

Astragalus aegobromus Boiss. & Hohen. (n=8). — Tehran: Taleghan area, Joestan to Gateh-Deh, (4 km before Gateh-Deh), 1700 m, 4.6.1986, Maassoumi 55157 (det. Podlech); Taleghan area, Zidasht, 1400 m, 4.6.1986. Maassoumi 55152; Taleghan area, Joestan to Gateh-Deh (4 km before Gateh-Deh), 4.6.1986, Maassoumi 55156 (det. Podlech); Taleghan

area, Zidasht, 1400 m, 4.6.1986, Maassoumi 55151 (det Podlech); 71 km on the road from Karaj to Chalus, 2200 m, 2.6.1986, Maassoumi 55109 and Maassoumi 55107. — Azarbayjan: Between Khalkhal and Ardabil, protected area of Lisar, Neor lake, 2500 m, 23.6.1986, Maassoumi & Abouhamzeh 56941 (det. Podlech).

Several specimens from different localities were examined. At the meiosis 8 homogenous chromosomes with intense chromosomal chromatinisation were recognized. In diakinesis slow chromosome terminalisation and synchronous disjunction are noticeable. This species is very variable and localised in the Alburz ranges. All specimens except no. 56941 from Azarbayjejan show the same characters. In the specimen from Azarbayjejan heterochromatine chromosomes are visible. Also, in the diakinesis, the mother cells show persistent nucleole. These characters diverge the specimen from *A. aegobromus*.

Astragalus angustiflorus C. Koch subsp. *angustiflorus* ($2n=16$, Fig. 5). — Azarbayjejan: 39 km from Mianeh to Khalkhal, 1800 m, 20.6.1986, Maassoumi & Abouhamzeh 56873.

Pretreatment of 0.05% colchicine in 3 hours before fixation of root tips

give the best result for the karyotype analysis. In metaphase the symmetrical karyotype and intense homochromatinisation of the chromosomes are distinguishable.

Astragalus avicennus Parsa ($n=8$, Fig. 3). — Hamadan: Ca. 11 km on the road from Songhor to Kangavar, 2000 m, 9.5.1987, Maassoumi & Mirhosseini 59312.

Heterogenous karyotypes were recognized. In diakinesis a tetravalent with slow chiasma terminalisation were distinguishable. In metaphase, short metacentric chromosomes were seen. Karyologically the species is close to *A. ovinus* Boiss. which is distributed largely in the same area.

Astragalus basilicus Maassoumi & Podl. ($n = 8$, Fig. 6). — Azarbayjejan: 8 km on the road from Khalkhal to Asalem (on deviation of Kolour), 1950 m, 20.6.1986, Maassoumi & Abouhamzeh 56907 (type specimen).

Homogenous karyotype with heterochromatinisation bivalents were seen. In metaphase the short metacentric chromosomes are recognized.

Astragalus brachystachys DC. ($2n=16$, Fig. 7). — Semnan: Momenabad, 1400 m Mozaffarian.

In the karyotype short telocentric chromosomes are recognized. Heterochromatinisation of chromosomes were seen.

Astragalus callainus Podl. (n=8).
Khorasan: 38 km from Kalat-e Naderi to Mashhad, 1170 m, 28.4.1986, Assadi & Maassoumi 55841 (type specimen).

In the karyotype homochromatinisation of bivalents were seen. Three bivalents with slow chiasma terminalisation and 5 bivalents with rapid chiasma terminalisation are recognized. In metaphase various position of centromers, 2 metacentric chromosomes were seen.

Astragalus citrinus Bge. subsp. *barrowianus* (n=8, Fig. 8). — Khorasan: Ca. 15 km W. of Kalat-e Naderi (GG2), 950 m, 27.4.1986, Assadi & Maassoumi 55809.

Astragalus ibicinus Boiss. & Hausskn. (n=8, Fig. 9). — Lorestan: Malavi to Eslamabad, 6km before Bolouran, 1500m, 6.5 1987, Maassoumi & Mirhosseini 59259.

In diakinesis the homochromatinisation of bivalents with rapid chiasma terminalisation can be recognized. In metaphase the short metacentric chromosomes were seen.

Astragalus inquilinus Maassoumi (n=8, Fig. 4). — Hamadan: Avadje, Sultan-Bulagh mts, 2000–2400 m, 12.5.1987,

Maassoumi & Mirhosseini 59383 (type specimen).

In diakinesis 8 bivalents with rapid chiasma terminalisation are recognized. In metaphase short metacentric chromosomes with the synchronous chromosomal disjunction are noticeable.

Astragalus kirpicznikovii Grossh. (2n=16). — Azarbayejan: 35 km from Ardebil to Germe, 21 km to Sadafarin region (after Khaje-Bulagh village), 1450 m, 23.6.1986, Maassoumi & Abouhamzeh 56953.

The mitosis karyotype shows the long metacentric chromosomes. Synchronous chromosomal disjunction and regular division are distinguished.

Astragalus lambinonii Podl. (2n=24, Fig. 10). — Hamadan: Hamadan to Malayer, ca. 19 km from diviation (Joekar) to Tuiserkan (Gazandar pass), 2000 m, 10. 5.1987, Maassoumi 59355.

Astragalus multijugus DC. (n=8, Fig. 11). — Hamadan: Ca. 21 km on the road from Nahavand to Malayer, 2000 m, 11.5.1987, Maassoumi & Mirhosseini 59373. — Lorestan: 10 km. on the road from Azna to Doroud, 1900 m, 5.5.1987, Maassoumi & Mirhosseini, 59235 (Fig. 11). — Zanjan: Ca. 36 km on the road to Mahneshan, 2250 m, 23.5.1987, Maassoumi

Homogenous karyotype with 8 small homochromatinised chromosomes were seen. In diakinesis, rapid chiasma terminalisation are distinguishable. Specimens from different localities show the same characters but specimen no. 59373 from prov. Hmadan in first anaphase shows the various degree of chiasma terminalisation.

Astragalus maymanensis Podl. (n=8). — Khorasan: Ca. 15 km of Kalat-e Naderi (GG2), 950 m, 27.4.1986, Assadi & Maassoumi 55810.

The specimen examined, showing the hard chromosomic agglutination in meiosis. It seems some pretreatments are necessary before fixation.

Astragalus monanthemus Boiss. (2n=14 + B). — Tehran: Damavand, Daryach-e Tar, 3700 m, 15.8.1984, Mozaffarian & Mohammadi 49287.

Astragalus ovinus Boiss. (n=8, Fig. 12). — Lorestan: Aligudarz, ca. 35 km from diviation to Shulabad, 2100 m, 4.5.1987, Maassoumi & Mirhosseini 59232.

Homogenous karyotype and slow chiasma terminalisation were seen. This species is karyologically similar to *A. avicennus*.

Astragalus pellitus Bge. (n=8, 2n=16). — Khorasan: 35 km to Sabzevar on the

road from Mashhad, 1350 m, 29.4.1986, Assadi & Maassoumi 55884. — Semnan: Touran protected area, sandy hills close to Yazdoo village, 1150 m, 10.5.1978, Freitag & Jadidi 28965.

The mitosis and meiosis divisions were examined. In meiosis the heterogenous karyotype and heterochromatinisation of the chromosomes were recognized. In the mitosis division the synchronous disjunction are noticeable.

Astragalus pinetorum Boiss. subsp. *declinatus* Podl. (n=8). — Gorgan: Kordkoy, protected area of Jahan-nema, 1800 — 2000 m, 21.5.1986, Maassoumi 55060. — Mazandaran: 86 km on the road from Shahmirzad to Sari (2 km before Kiasar village), 1620 m, 19.5.1986, Maassoumi 55021.

This subspecies in some respects is similar to subsp. *pinetorum* but the heterogenous karyotype with heterochromatinised bivalents in diakinesis are recognized.

Astragalus pinetorum Boiss. subsp. *pinetorum* Podl. (n=8, Fig 13). — Azarbayejan: Khalkhal, 18 km on the road from Khalkhal to Kivi (protected area of Lombor), 1800 — 2300 m, 21.6.1986, Maassoumi & Abouhamzeh 56915; Ardabil, Sabalan mt., Shabil region, 2400—2700m, 24.6.1986, Maassoumi &

Abouhamzeh 56959; between Khalkhal and Ardabil (protected area of Lisar, Neor lake), 2500 m, 23.6.1986, Maassoumi & Abouhamzeh 56945 (Fig. 13).

In meiosis 8 homogenous chromosomes were seen, during metaphase very short metacentric chromosomes and slow chiasma terminalisation are noticeable. This subspecies in chromatinisation of bivalents is immediately distinguishable from subsp. *declinatus*.

Astragalus piranshahricus Maassoumi & Podl. (2n=16, Fig. 14). — Kordestan: Marivan, Garan pass, 2300 m, 8.9.1985, Mozaffarian 49017 (paratype specimen).

In mitosis prophase 16 short metacentric chromosomes were seen. Synchronous chromosomal disjunction was distinguished.

Astragalus pseudoindurascens Sirj. & Rech. f. (2n=16, Fig. 2.) — Khorasan: Esferayen, Shah Jahan mt. region, Sarcheshmeh village, 1700 m; 26.6.1984, Mozaffarian 48410.

Homogenous karyotype and intense homochromatinisation were seen. In the karyotype, short metacentric chromosomes are distinguishable.

Astragalus pseudovinus Maassoumi & Podl. (n=8, Fig. 15). — Hamadan: Avadje, Sultan-Bulagh mts., 2000–2400 m, 12.5.

1987, Maassoumi & Mirhosseini 59379 (Fig. 15); ca. 21 km on the road from Nahavand to Malayer, 2000 m, 11.5.1987, Maassoumi 59372.

Two specimens collected near the type locality were examined. In the meiosis stages homogenous karyotype and intense chromosomal homochromatinisation are recognized. Symmetrical karyotype with short submetacentric chromosomes were seen. Karyological analysis show karyotype similarity with a close relative, *A. avicennus* distributed in the same area.

Astragalus remotijugus Boiss. (n=8, 2n=16, Fig. 16). — Tehran: Karaj, Gachsar to Gajereh (2 km after deviation), 2300 m, 2.6.1986, Maassoumi 55112, 51 km on the road from Karaj to Chalus (before deviation of Shahrestanak), 2200 m, 2.6.1986, Maassoumi 55099. (Fig. 16); W. of Tehran, Sangam, 24.6.1986, Jamzad 57085.

In diakinesis 8 homochromatinised bivalents were seen. In metaphase slow chiasma terminalisation and synchronous chromosomal disjunction are recognized.

Astragalus semilunatus Podl. (2n=16). — Hamadan: Avadje, Sultan-Bulagh mts., 2000–2400 m, 12.5.1987, Maassoumi & Mirhosseini 59382.

Astragalus urmiensis Bge. ($2n=16$, Fig. 17). — Hamadan: Avadje, Sultan-Bulagh mts., 2000–2400 m., 12.5.1987, Maassoumi & Mirhossein 59377.

Homogenous karyotype with long chromosomes were seen.

Astragalus vereskensis Maassoumi & Podl. ($n=8$, Fig. 18). — Mazandaran: Pol-e Sefid, 20 km before Firouz-kuh, 2000 m, 24.5.1986, Maassoumi 55098; Pol-e Sefid, 40 km before Firouz-kuh, 1400 m, 24.5.1986, Maassoumi 55097 (Fig. 18); 82 km on the road from Shahmirzad to Sari (6 km before Kiasar), 1630 m, 19.5.1986, Maassoumi 55019.

The specimens collected near the type locality were examined. In diakinesis the heterogenous bivalents are recognized. In first anaphase the synchronous chromosomal disjunction with the small chromosomes are noticeable.

This species in some respects especially on the indumentum is very variable, but this kind of variation is not interpretable by the karyological analysis.

Astragalus vulcanicus Bornm. ($n=8$, Fig. 19). — Mazandaran: Haraz road, Ab-e Ask, 2200 m, 3.6.1986, Maassoumi 55134.

The specimen collected in type locality was examined. In the karyotype

the homochromatinisation bivalents are noticeable. In diakinesis the short bivalents and 8 rapid chiasma terminalisation were recognized. The karyological analysis shows that this species is close to *A. multijugus* DC.

Sect. *Dasyphyllum* Bge.

Astragalus deickianus Bornm. ($n=8$). — Hamadan: Avadje, Sultan-Bulagh mt., 2000–24000 m, 12.5.1987, Maassoumi & Mirhosseini 58381.

Sect. *Hypoglottidei* DC.

Astragalus rimarum Bornm. ($2n=16$). — Tehran: Karaj, Kandawan, Asadbar to Gerab, Assalak pass (locus classicus), 2900–3000 m, 9.6.1987, Maassoumi 59427.

Sect. *Laxiflori* Agere-Kirchhoff

Astragalus tawlicus C.C. Townsend ($n=8$). — Hamadan: Hamadan to Malayer, ca. 19 km from diviation (Joekar) to Tuiserkan (Gazandar pass), 2000 m, 10.5.1987, Maassoumi 59351.

Sect. *Malacothrix* Bge.

Astragalus eriopodus Boiss. ($n=13$). — Hamadan: Avadje, Sultan-Bulagh mts, 2000–2400 m, 12.5.1987, Maassoumi &

Mirhosseini 59378.

Sect. *Theiochrus* Bge.

Astragalus siliquosus Boiss. subsp. *siliquosus* (n=8). — Hamadan: Ca. 21 km on the road from Nahavand to Malayer, 2000 m, 11.5.1987, Maassoumi & Mirhosseini 59363.

Astragalus sp. (n=8). — Hamadan: Hamadan to Malayer, ca. 19 km from diviation (Joekar) to Tuiserkan (Gazandar pass), 2000 m, 10.5.1987, Maassoumi 59350.

Sect. *Tricholobus* Bge.

Astragalus hohenackeri Boiss. (n=8). — Zanjan: Zanjan to Mahneshan, 24 km on the road to Angoran, just on the diviation of Inche village, 2300 m, 23.5.1987 Maassoumi, s. n.

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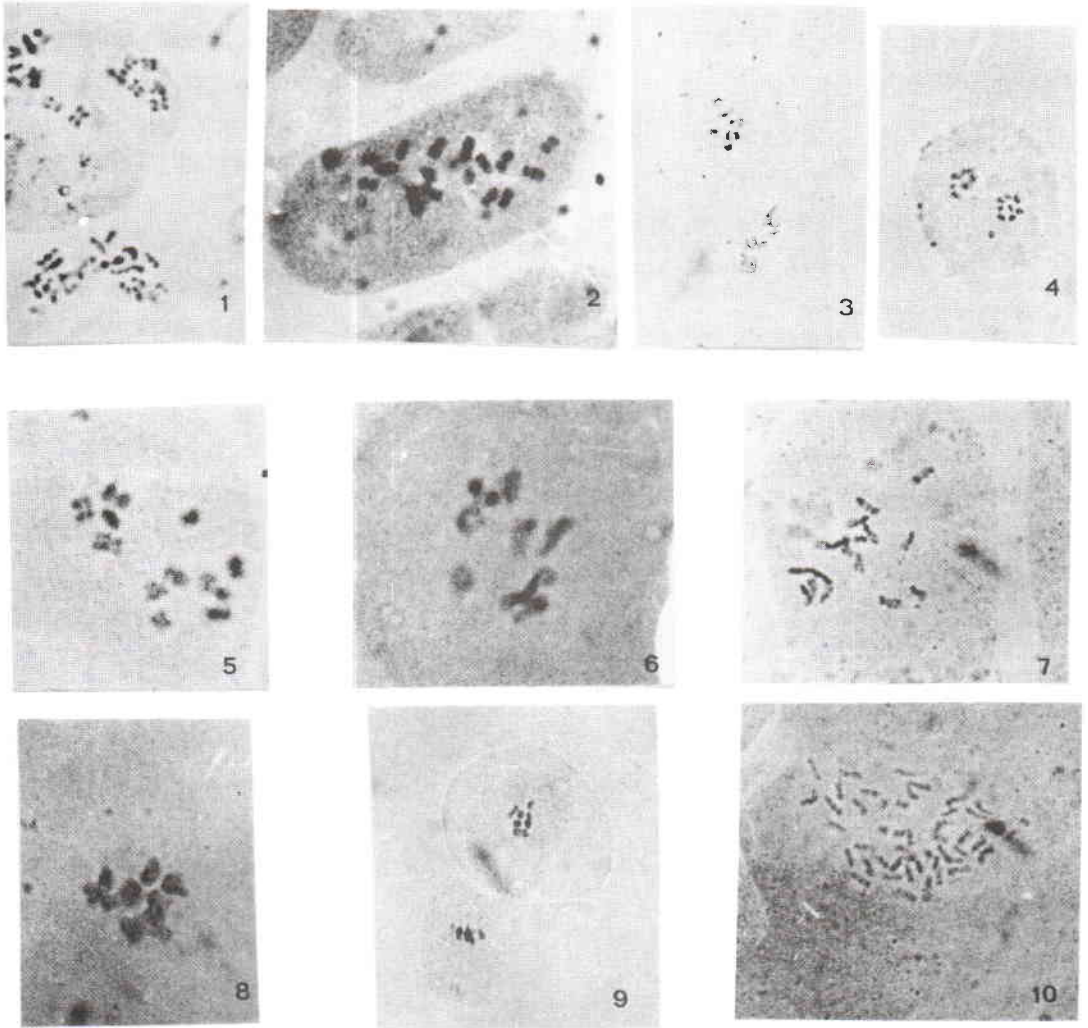


Fig. 1—10: 1. *A. caryolobus*, mitosis metaphase (x1850). — 2. *A. pseudoindurascens*, mitosis prophase (x3750). — 3. *A. avicennus*, diakinesis (x1850). — 4. *A. inquilinus*, anaphase I (x1850). — 5. *A. angustiflorus* ssp. *angustiflorus*, mitosis metaphase (x3750). — 6. *A. basilicus*, diakinesis (x3750). — 7. *A. brachystachys*, mitosis prophase (x3750), — 8. *A. citrinus* ssp. *barrowianus*, diakinesis (x3750). — 9. *A. ibicinus*, diakinesis (x 1850). — 10. *A. lambinonii*, mitosis prophase (x3750).

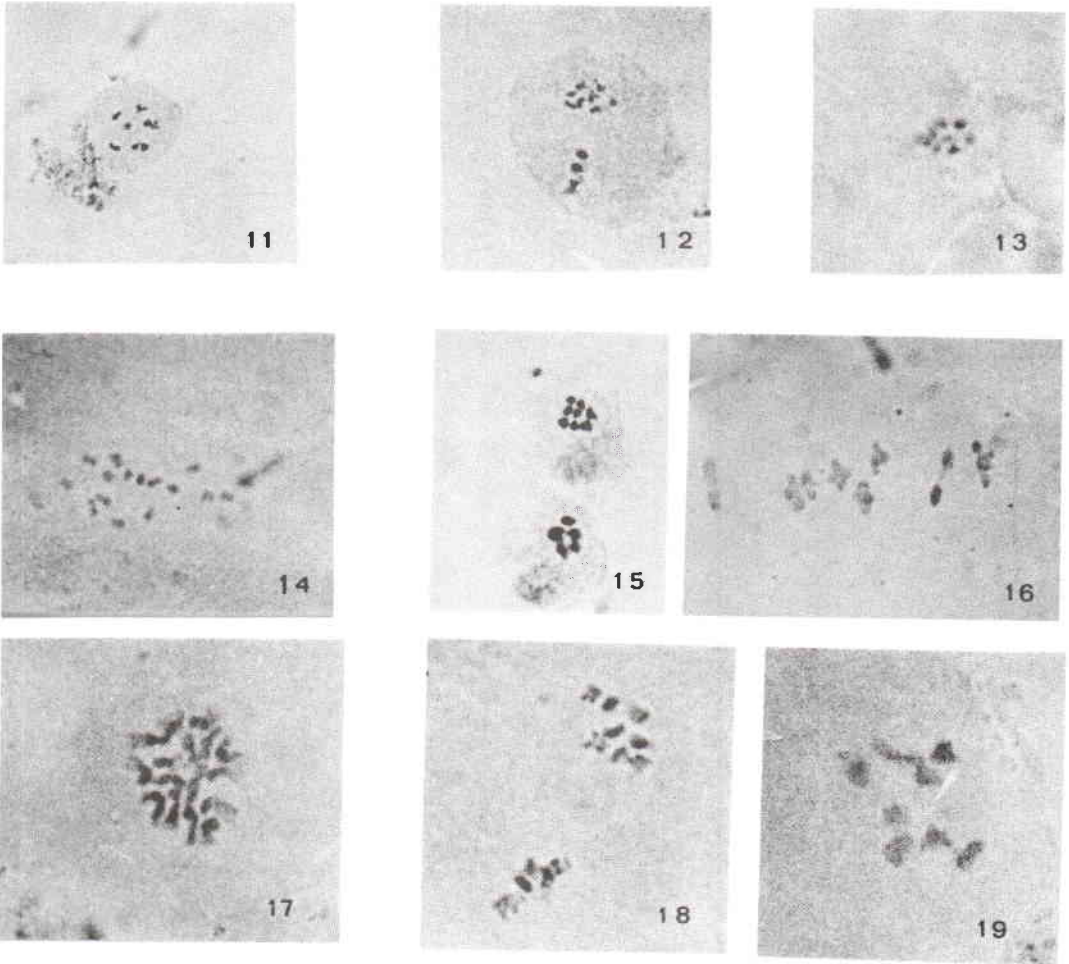


Fig. 11–19: 11. *A. multijugus*, diakinesis (x1850). — 12. *A. ovinus*, anaphase I (x1850). — 13. *A. pinetorum* ssp. *pinetorum*, diakinesis (x 3750). —14. *A. piran-shahricus*, mitosis prophase (x3750). — 15. *A. pseudovinus*, anaphase I (x1850). — 16. *A. remotijugus*, metaphase I (x 3750). —17. *A. urmiensis*, mitosis in the ovary (x3750). —18. *A. vereskensis*, anaphase I (x3750). — 19. *A. vulcanicus*, diakinesis (x3750).