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Karyotaxonomy of some medicinal and aromatic plants

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ABSTRACT: The present paper deals with chromosome numbers of some medicinal and aromatic plants that are cultivated in Slovakia. Some of them might originate from Slovakian wild flora, while some of them belong to introduced and already cultivated plants in other countries. They are as follows: *Achillea millefolium* 2n=81±5, *Agrimonia eupatoria* 2n=28, *A.grandis* 2n=42, *Artemisia absinthium* 2n=18, *A. dracunculus* 2n=90, *Calendula officinalis* 2n=32, *Chamomilla recutita* 2n=18, *Datura stramonium* 2n=24, *Digitalis lanata* 2n=56, *D.purpurea* 2n=56, *Echinacea pallida* 2n=44, *E.purpurea* 2n=22, *Foeniculum vulgare* 2n=22, *Galega officinalis* 2n=16, *Hypericum perforatum* 2n=32, *Lavandula officinalis* 2n=54, *Hyssopus officinalis* 2n=12, *Leonurus cardiaca* 2n=18, *Levisticum officinale* 2n=22, *Malva mauritiana* 2n=42, *Melissa officinalis* 2n=32, *Marrubium vulgare* 2n=34, *Mentha spicata* 2n=48, *Ocimum basilicum* 2n=48, *Papaver somniferum* 2n=22, *Plantago lanceolata* 2n=12 & 24, *Rhaponticum orientale* 2n=24, *Salvia officinalis* 2n=14, *S.sclarea* 2n=22, *Saponaria officinalis* 2n=28, *Satureja montana* 2n=30, *Thymus vulgaris* 2n=30, *Valeriana angustifolia* 2n=28, *Verbascum densiflorum* 2n=36.

KEYWORDS: karyotaxonomy, medicinal and aromatic plants.

Introduction

Karyotaxonomical research of the Slovakian flora has now included into its programme also the cultivated plants and among them the medicinal and aromatic ones. Some of the species could be found growing wildly in the local flora but some have been introduced. For those in the cultivation we would like to find if the artificial selection or breeding respectively, selected or bred new polyploids. The reasons for introduction of new polyploids might be the bigger size of the plants and higher content of the medical or aromatic substances.

We could also expect that some of the introduced taxa might escape from garden to the field and get into contact with the local populations of native plants. The result could be an increase of the variability by their presence in the new habitat or by hybridization with the native plants.

Such possibility depends greatly on the ploidy level of the plants in question. Therefore the chromosome numbers of both types should be known and taken into consideration for floristic and cultivation purposes.

Material and methods

The karyological studies were performed with the seedling root tips. The seeds from the Seed Companies or Botanical Garden, Faculty of Pharmacy, Comenius University, Bratislava (further Bot. Gard. Pharm. Fac. UK) were used. The seeds were germinated in Petri dishes on wet filter papers. Seedlings with the roots of about 5 to 10 mm were chosen for the karyological procedures. The root tips were pretreated with saturated solution of para-dichlorobenzene for 3 h and fixed in a mixture of ethanol and acetic acid (3:1) for 1 to 24 h. Storage was applied in some cases and in that case the 70% ethanol was used. Permanent squashes were made by means of cellophane technique (MURÍN 1960) and the temporary ones in a drop of propionic orcein.

Results and discussion

1. *Achillea millefolium* L.

Present count

2n = 81 ± 5 MURÍN, seeds from: Bot. Gard. Pharm. Fac. UK ut *A. millefolium* L.

Previous data and comment

2n = 18 (9 refs.)

2n = 36 (22 refs.)

2n = 45 (1 ref.)

2n = 54 ut *A. millefolium* L. s. str. CLAUSEN J., KECK § HIESEY 1938, 1939, 1940, 1948, TURESSON 1938, LÖVE & LÖVE 1944, 1956, VAARAMA in LÖVE & LÖVE 1948, SUZUKA & KORIBA 1949, EHRENDORFER 1952, 1953, 1959, 1973, EHRENDORFER in JANCHEN 1958, MULLIGAN & BASSET 1959, HABEROVÁ 1963, LÖVKVIST in WEINMARCK 1963, BRIGGS & WALTERS et al.1965, LAANE 1965, GADELLA & KLIPHUIS 1966, 1973, CHUKSANOVA, SVESHNIKOVA & ALEKSANDROVA 1968, TYRL 1969, HIESEY & NOBS 1970, PLCHOVÁ et al. 1970, OSWIECZIMSKA 1968, SUŠNIK, DRUŽKOVIČ, LÖVE & LÖVE 1972, DABROWSKA 1972, POJAR 1973, MEHRA & REMANANDAN 1974, MARCHI, CAPINERI & D'AMATO 1974, FAASEN & NADEAU 1979, GUPTA & GILL in LÖVE 1981, ANDROSHCHUK et al. 1984, LIPPERT & HEUBL 1988, KUZMANOV et al. 1989.

2n = 63 (1 ref.)

2n = 72 (12 refs.)

2n = 81 ± 5 (present result)

This taxon is very complex and polyploidy with hybridization played an important role in its evolution. As shown in the survey we can find in literature a series of chromosome numbers under this name. Karyology, however, contributed significantly to the present taxonomy of this complex what resulted in more precise classification of the taxa at the specific and subspecific level. Thus in the Flora Europaea eight species from this complex are recognized (cf. RICHARDSON in TUTIN et al. 1976) and in Slovakian flora we recognize 4 species with chromosome numbers 2n=18, 36, 54 and 72 (cf. MÁJOVSKÝ, MURÍN et al. 1987).

From karyotaxonomical point of view the most frequent chromosome number is 2n = 54 which is characteristic for *A. millefolium* L. s. str. But even this species is also polymorphic and at present two subspecies are recognized i. e. subsp. *millefolium* and subsp. *sudetica* (OPIZ) WEISS, both with the same chromosome number 2n = 54. The cultivated plants with the chromosome number 2n = 81 ± 5 could originate from subsp. *millefolium* either in wild or cultivated populations. We can expect that in common hexaploid populations with 2n = 54 some individuals might appear as a result of fertilization between reduced (2n = 27) and unreduced (2n = 54) gametes giving rise to nonaploid (2n = 81). The plants grown from the mentioned seeds were twice as tall as the wild ones and the corymbs and capitula were also enlarged. This could be an advantage for further selection and breeding. There is, however, one great disadvantage which concerns the fertility of this nonaploid plants, which is very low when compared to the hexaploids. This disadvantage can be partly overcome by vegetative propagation that is quite easy because it is characteristic trait of the species. It is also worthy of consideration that interspecific hybridization is common, so new polyploids could be achieved and compared as to the quantity and quality of the drugs.

For our country the cultivation of this medicinal plants is not so urgent because the wild growing populations seem to be sufficient for this purpose. Nevertheless, further selection and breeding could be successful.

2. *Agrimonia eupatoria* L. (Syn.: *A. eupatoria* L. subsp. *eupatoria*)

Present count

2n = 28 MURÍN, seeds from: SEVA-FLORA Valtice

Previous data and comment

2n = 28 WULFF 1938, MAUDE 1939, 1940, BRITTAN 1953, LÖVE 1954, MEED 1955, CZAPIK in SKALIŃSKA et al. 1959, PODLECH & DIETERLE 1969, MURÍN & VÁCHOVÁ in MÁJOVSKÝ et al. 1970, PALKOVÁ in MÁJOVSKÝ et al. 1970, AROHONKA 1982, LÖVE & LÖVE 1982, DMITRIEVA & PARFEMOV 1983, UBERA 1983, LEQUE et al. 1984, DALGAARD 1986, AFZAL-RAFII et al. 1986, GHAFARI 1987.

This tetraploid species is rather common in our flora, though heavy collections for medicinal purposes can enforce its cultivation also in our country. Along with this species and under the same name we have received the seeds of hexaploid (2n = 42) taxon which we later could determine as *A. grandis* ANDRZ. ex ASCHERS. et GRAEBN. The question might arise which of the two species is more suitable for cultivation and for the yield of the drugs. For more comment see the next species.

3. *Agrimonia grandis* ANDRZ. ex ASCHERS. et GRAEBN.
Syn.: *A. eupatoria* subsp. *grandis* (ANDRZ. ex ASCHERS. et GRAEBN.)Bonm.

Present count
2n = 42 MURÍN, seeds from: Bot. Gard. Pharm. Fac. UK, Bratislava
Previous data and comment
Survey of the available literature has shown that no previous count has been recorded in existing Chromosome Number Indexes.

It is surprising that new chromosome count has been found though the seed sample was labelled as *A. eupatoria* L. Further study, however, has shown that this sample with 2n = 42 had hypanthium resembling that of subsp. *grandis* while that one with 2n = 28 resembled rather another subspecies i. e. subsp. *eupatoria*. According to some other morphological characters of the grown plants we could determine them as *A. eupatoria* L. s. str. with 2n = 28 and *A. grandis* ANDRZ. ex ASCHERS. et GRAEBN. with 2n = 42. The next question should be solved which of the two species is more suitable for cultivation and for the higher yield of the drug.

A. grandis is distributed mostly in South-East Europe and this region can be the place of origin of those plants already in cultivation. Because of the hexaploid level and the new chromosome chromosome count it would be advisable to find if the the same advisable number of chromosomes is characteristic for the native plants as well.

4. *Artemisia absinthium* L.

Present count
2n = 18 MURÍN, seeds from: Bot. Gard. Pharm. Fac. UK, Bratislava
Previous data and comment
2n = 18 WEINEDEL-LIEBAU 1928, SUZUKA 1949, 1952, SUZUKA & KORIBA 1949, PÓLYA 1950, KHOSHOO & SOBTI 1958, URBAŃSKA in SKALIŃSKA, CZAPIK & PIOTROWICZ 1959, LÖVKVIST in WEIMARCK 1963, KAWATANI & OHNO 1964, KOUL 1964 , 1964 , HINDÁKOVÁ & ČINČURA 1968, PODLECH & DIETERLE 1969, VÁCHOVÁ & FERÁKOVÁ 1986, MORTON 1972, MEHRA REMANANDAN 1974, BHAT, BAKSHI & KAUL in LÖVE 1974, MORTON 1977, MCARTHUR & POPE in LÖVE 1977, ŽUKOWSKI & SLOWINSKA 1979, NAGL & EHRENDORFER 1974, MORTON 1981, AFZAL-RAFII et al. 1985, KAUL & BAKSHI 1984, KUZMANOV et al. 1986, MENDELAK & SCHWEIZER 1986, SEMERENKO et al. 1989, VERLAQUE et al. 1987, OUYAHVA & VIANO 1988, STAHEVITCH & WOITAS 1988.

All the previous counts are the same and indicate high stability in chromosome number for both the native and cultivated plants.

5. *Artemisia dracunculus* L.

Present count
2n = 90 MURÍN, seeds from: ROYAL SLUIS
Previous data and comment
2n = 18 WEINEDEL-LIEBAU 1928, LÖVE & LÖVE 1964, PODLECH & BADER 1974, POWEL, KYHOS & RAVEN 1974, ZHUKOVA et al.1977, MORTON 1981, KROGULEVICH 1984, KRASNIKOV 1985, MENDELAK & SCHWEIZER 1986

2n = 36 KAWATANI & OHNO, ROUSI 1969

2n = 54 KAWATANI & OHNO 1964, ROSTOVTSEVA 1979

2n = 72 KAWATANI & OHNO 1964

2n = 90 ROUSI 1969

In comparison with the previous species of the same genus (*A. absinthium* L.) this one is represented by a series of polyploids i.e. tetraploids, hexaploids, octoploids and decaploids. Our count 2n = 90 shows that artificial selection has involved also this high polyploidy level (see SUTTON S., HUMPRIES C. & HOPKINS J., 1985: The Garden 110: 237-250).

6. *Calendula officinalis* L.

Present count

2n = 32 MURÍN, seeds from: LEROS Praha

Previous data and comment

2n = 32 WEDDLE 1941, JANAKI AMMAL & SOBTI 1962, MEHRA et al. 1965, MEUSEL & OHLE 1966, GUPTA 1969, HAZRA 1970, OHLE 1974, MEHRA & REMANANDAN 1976, GUPTA & GILL 1983, CZAPIK et al. 1989, MATHEW & MATHEW 1988, BALTISBERGER & HUBER 1987, GUPTA & GILL 1989.

Our count is in agreement with the previous ones and indicates high stability of the tetraploid level. The question is whether diploid parents could survive somewhere in the Mediterranean region. Its origin is still uncleare but may be also in SW Europe as indicated by HEYWOOD & ZOHARY (1995, p. 408).

7. *Chamomilla recutita* (L.) RAUSCHERT

Syn.: Matricaria recutita L.

Present count

2n = 18 MURÍN, seeds from: SEVA FLORA Valtice

2n = 18 MURÍN, seeds from: Bot. Gard. Pharm. Fac. UK,Bratislava

Previous data and comment

2n = 18 LUNDEGARDH 1909, BEER 1912, HARTWICH 1936, MAUDE 1939, PÓLYA 1947, LÖVE & LÖVE 1948, PÓLYA 1948, TARNAVSCHI 1948, SUZUKA & KORIBA 1949, HARLING 1951, LÖVKVIST in WEIMARCK 1963, KOUL M. L. 1964, GADELLA & KLIPHUIS 1966, FERNANDES A. & QUEIROS 1971, NORDESTAM 1972, MORTON 1977, CZAPIK in POGAN & RYCHLEWSKI 1980, PENEVA et al. 1988.

This species seems to be well established as diploid both in nature and culture.

8. *Datura stramonium* L.

Present count

2n = 24 MURÍN, seeds from: Bot. Gard. Pharm. Fac.UK, Bratislava

Previous data and comment

2n = 24 BÖNICKE K. VON 1911, BELLING & BLAKESLEE A. F. 1924, BLAKESLEE A. F., MORISON G. & AVERY A.G. 1927, BLAKESLEE A. F. 1928, LEVITSKY 1930, BLAKESLEE A. F. 1931, 1932, 1934, YAMAMOTO K. & SAKAI K. 1932, BERGNER, SATINA & BLAKESLEE A. F. 1934, BLAKESLEE A. F., SATINA S., AVERY A. G.,

BERGNER, CARTLEDGE & BUCHHOLZ 1935, BLAKESLEE A. F., BERGNER & AVERY A. G. 1937, BERGNER 1943, SATINA 1960, LÖVKVIST in WEIMARCK 1963, BAQUAR 1967, MADHAVADIAN 1968, MURÍN in MÁJOVSKÝ 1970, VASUDEVAN 1975, TURALA-SZYBOWSKA in SKALIŃSKA 1976, LESSANI & CHARIAT-PANAHI in LÖVE 1979, BIR & NEELAM 1984, DALGAARD 1986, PALOMINO et al. 1988

There are quite numerous counts showing the diploid status of this species both in nature and culture.

9. *Digitalis lanata* EHRH.

Present count

2n = 56 MURÍN, seeds from: Bot. Gard. Pharm. Fac.UK, Bratislava

Previous data and comment

2n = 56 BUXTON & DARK 1934, OLAH 1952, BUTTERFASS 1960, TARNAVSCHI & LUNGEANU 1967, GADELLA & KLIPHUIS 1972, GILL 1972, YAKAR-TAN 1979, LOON VAN & SETTEN VAN 1982, MURÍN in MÁJOVSKÝ, MURÍN et al. 1987.

Our and the other data show the octoploid status of the species both native or cultivated. It could be found also in Slovakian flora, where it grows as an escape at single locality. (cf. MÁJOVSKÝ, MURÍN et al. 1987).

10. *Digitalis purpurea* L.

Present count

2n = 56 MURÍN, seeds from: Bot. Gard. Pharm. Fac. UK, Bratislava

Previous data and comment

2n = 48 HAASE-BESSEL 1916, 1921, SUBRAMANIAN & PONDMUDI 1987, PROBATOVA & SOKOLOVSKAYA 1989

2n = 56 BUXTON & NEWTON 1928, HUSKINS 1928, MICHAELIS 1931, BUXTON & DARK 1934, REGNART 1935, SAKAI K. 1935, YAKAR 1945, TARNAVSCHI & LUNGEANU 1967, VERMA & DHILLON in LÖVE 1967, HSU 1968, TAYLOR & MULLIGAN 1968, FERNANDES et al. 1977, CHANDRAN & BHAVANANDAN 1987, FREEMAN & BROOKS 1988.

Our sample has been found to be octoploid, though some hexaploids were also reported by few authors (HEYWOOD & ZOHARY 1995, however, did not take them into consideration).

11. *Echinacea pallida* (NUTT.) NUTT.

Present count

2n = 44 MURÍN, seeds from: Bot. Gard. Pharm. Fac. UK, Bratislava

Previous data and comment

2n = 44 PERDUE 1959, MCGREGOR 1968, LÖVE & LÖVE 1982.

Although the seeds were labeled as *E. angustifolia* after counting the chromosome number it appeared to be more or less clear that this sample belongs to *E. pallida* (NUTT.) NUTT. It has been confirmed by determination of the living plants cultivated from these seeds. It is highly probable that also some other plants cultivated in Europe as medicinal or ornamental plants belong to this species which is tetraploid (2n = 44), while the *E. angustifolia* DC. is diploid 2n = 22.

12. *Echinacea purpurea* MOENCH

Present count

2n = 22 MURÍN, seeds from: Bot. Gard. Pharm. Fac. UK, Bratislava

Previous data and comment

2n = 22 HEISER & SMITH 1955, MCGREGOR 1968, JONES S. B. JR. 1970, POGAN et al. 1986.

All the previous counts including our's fall in line and indicate the diploid level of the species in nature and culture.

13. *Foeniculum vulgare* MILLER

Present count

2n = 22 MURÍN, seeds from: Bot. Gard. Pharm. Fac. UK, Bratislava

Previous data and comment

2n = 22 OGAWA 1929, MELDERIS 1930, WANSCHER 1931,1932, TAMAMSHYAN 1933, DELAY C. 1947, HEISER & WHITAKER 1948, GARDE A. & MALHEIROS-GARDE 1949, SHARMA A. K. & BHATTACHARYYA 1957, MITSUKURI Y. & KURAHDRI 1959, SHARMA A. K. & BHATTACHARYYA N. K. 1959,1960, CARTIER 1960, RAGHUVANSHI S. S., JOSHI S. 1966, KORDYUM 1967, QUEIROS 1972, 1974, LABADIE in LÖVE 1982, HAMAL et al. 1986, SUBRAMANIAN 1986, CHATTOPADHYAY & SHARMA 1989, LI R. 1989, GE et al. 1989, DAS & MALLICK 1989, KRISHNAPPA & BASAPPA 1988

The diploid chromosome number 2n=2x=22 for this species is confirmed also by our result.

14. *Galega officinalis* L.

Present count

2n = 16 MURÍN, seeds from: LEROS Praha

Previous data and comment

2n = 16 KREUTER 1929, CHEKHOV 1930, KREUTER 1930, CHEKHOV 1935, SENN 1938, GARDE A. & MALHEIROS-GARDE 1953, ZHUKOVA 1967, HINDÁKOVÁ & ČINČURA 1967, KOŽUHAROV, KUZMANOV & MARKOVA T. in LÖVE 1972, DVOŘÁK & DADÁKOVÁ in LÖVE 1975, FERNANDES & QUEIROS 1978, ŠOPOVA & SEKOVSKI 1989.

The diploid chromosome number for this species is generally approved.

15. *Hypericum perforatum* L.

Present count

2n = 32 MURÍN, seeds from: Bot.Gard.Pharm.Fac.UK, Bratislava

Previous data and comment

2n = 32 NIELSEN N. 1924, WINGE O. 1925, HOAR C. S. & HAERTEL 1932, NOACK 1939, MULLIGAN 1957, ROBSON 1957, 1958, LÖVKVIST in WEIMARCK 1963, HEDBERG I. & HEDBERG O. 1964, GAGNIEU & WILHELM 1965, GADELLA & KLIPHUIS 1966, 1970a, ROBSON & ADAMS 1968, GARAJOVÁ in MÁJOVSKÝ 1970a, NILSSON Ö. & IASSEN

1971, HOLUB, MĚSÍČEK & JAVŮRKOVÁ 1972, REYNAUD 1973, WCISLO in POGAN et al. 1980, LÖVE & LÖVE in LÖVE 1982, KAPOOR in LÖVE 1982, REYNAUD 1986, HILL et al. 1989.

2n = 48 REYNAUD 1986.

Our sample shows the tetraploid chromosome number (2n=2x=32) as given by many other authors except REYNAUD (1986) who refers to both the tetraploid and hexaploid number.

16. *Hyssopus officinalis* L.

Present count

2n = 12 MURÍN, seeds from: ŠÚ Troubsko u Brna

Previous data and comment

2n = 12 JANAKI-AMMAL in DARLINGTON & JANAKI AMMAL 1945, DELAY C. 1947, SUZUKA & KORIBA 1951, REESE 1952, MARKOVA & NGUEN THI THU in LÖVE 1974.

Our count falls in line with those of other authors.

17. *Lavandula officinalis* CHAIX

Present count

2n = 54 MURÍN, seeds from: Bot. Gard. Pharm. Fac. UK, Bratislava

Previous data and comment

2n = 36 LAWS D. 1390

2n = 42, 48 BUYUKLI 1970

2n = 54 GARCIA 1942, DELAY 1947

This species appears to be variable in the chromosome number and our count suports those with 2n = 54, thus indicating the hexaploid level.

18. *Leonurus cardiaca* L.

Present count

2n = 18 MURÍN, seeds from: LEROS Praha

Previous data and comment

2n = 18 WULFF 1939, RUTLAND 1941, TARNAVSCHI 1948, PÓLYA 1949, MULLIGAN 1961, LÖVKVIST in WEIMARCK 1963, GILL L. S. 1970, MURÍN & UHRÍKOVÁ in MÁJOVSKÝ et al. 1970, PODLECH & BADER 1974, JANKUN in POGAN et al. 1980, SAGGOO 1983, GILL 1981,1983, SAGGOO & BIR 1983, DMITRIEVA 1985, GILL 1984, SOPOVA et al. 1983, BIR & SAGGOO 1984, AROHONKA 1982, HILL et al. 1989.

Our count is a confirmation of previous ones. The native plants of Slovakian flora are also diploids (2n=2x=18).

19. *Levisticum officinale* Koch

Present count

2n = 22 MURÍN, seeds from: LEROS Praha

Previous data and comment

2n = 22 MELDERIS 1930, DELAY 1947, CZAPIK in POGAN et al.1982, VÁCHOVÁ in MÁJOVSKÝ, MURÍN et al.1987. Our count is in agreement with the previous ones.

20. *Malva mauritiana* L.

Present count

2n = 42 MURÍN, seeds from: LEROS Praha

Previous data and comment

2n = 42 PROBATOVA & SOKOLOVSKAYA 1986, PROBATOVA et al. 1986

Our count confirms the hexaploid level of the species /2n=6x=42/.

21. *Marrubium vulgare* L.

Present count

2n = 34 MURÍN, seeds from: SEVA FLORA Valtice

2n = 34 MURÍN, seeds from: LEROS Praha

Previous data and comment

2n = 34 RUTLAND 1941, EPLING in HEISER & WHITAKER 1948, TARNAVSCHI 1948, LARSEN K. 1960, DIERS 1961, MURÍN & VÁCHOVÁ in MÁJOVSKÝ et al. 1970, BOTHMER VON 1970, MARKOVA M. L. & IVANOVA in LÖVE 1971, MORTON J. K.1973.

Our count for these samples appeared to be the same as given by other authors and found as native also in Slovakian flora.

22. *Melissa officinalis* L.

Present count

2n = 32 MURÍN, seeds from: ŠÚ Troubsko u Brna

2n = 32 MURÍN, seeds from: Bot. Gard. Pharm. UK, Bratislava

Previous data and comment

2n = 32 LITARDIERE 1946, REESE 1952, MARKOVA & NGUEN THI THU in LÖVE 1974, LÖVE & LÖVE 1982.

Our two counts fall in line with previous ones given by other authors.

23. *Mentha spicata* L.

Present count

2n = 48 MURÍN, seeds from: MORAVOSEEDS Mikulov

Previous data and comment

2n = 48 RUTTLE 1931, NAGAO 1941, JUNELL in LÖVE & LÖVE 1942, PÓLYA 1949, SUZUKA & KORIBA 1949, MORTON 1956, MURRAY 1958, 1960, 1963, SHARMA & BHATTACHARYYA 1958, BUQUAR & REESE 1965, SOBTI 1965, OUWENEEL 1968, SACCO & SCANNERINI 1968.

The seeds were labeled as *Mentha piperita.* But *M.* x *piperita* L. is believed to be a hybrid between *M. aquatica* and *M. spicata,* thus (2n=8x=48) x (2n=18x=96). The intermediate chromosome number is commonly found to be 2n = 72. Our count 2n=8x=48 is indicating only one of the parents i. e. *M. spicata.* This species grows also in Slovakia and its chromosome number is the same. Its exact origin is unknown. According HEYWOOD & ZOHARY (1995, p. 405) it may have arisen in cultivation.

24. *Ocimum basilicum* L.

Present count

2n = 48 MURÍN, seeds from: Bot. Gard. Pharm. Fac. UK, Bratislava

Previous data and comment

2n = 16 BORSOS SZ. 1970

2n = 48 VAARAMA 1947a, 1954, MORTON J. K. 1962, PUSHPANGADAN & SOBTI 1982, SAGGOO 1983, SINGH 1985, SAGGOO & BIR 1983, BIR & SAGGOO 1985, MA X. et al. 1984, GILL 1984, SINGH 1986, GE C. J. 1987

2n = 52 SINGH 1952, SINGH 1986

2n = 68 CHERIAN & KURIACHAN 1981.

As shown in the survey of chromosome numbers for this taxon, the majority of data indicate the hexaploid level (2n=6x=48) and our count falls in line with those references. The other counts are also interesting and among them mainly the diploid number 2n = 16 (if correct).

25. *Papaver somniferum* L.

Present count

2n = 22 MURÍN, seeds from: MORAVOSEED Mikulov

Previous data and comment

2n = 22 TAHARA 1915, LJUNGDAHL 1922, YASUI 1927, KUZMINA 1935, SUGIURA 1940, VOLOTOV 1941, CASTIGLIA 1955, KAVATANI, ASAHINA et al. 1957, 1959, HRISHI 1960, ERNST W. R.1965, ZHUKOVA 1967, FERNANDES & QUEIRÓS 1971, KOUL et al. 1972, OJALA & ROUSI 1986, KADEREIT 1986,1987, KADEREIT et al. 1988.

According to the survey the diploid chromosome number is generally represented in this taxon, and our count is its another confirmation.

26. *Plantago lanceolata* L.

Present count

2n = 12 MURÍN, seeds from: Gard of Bot. Dept. Fac. Sci. UK, Révová 39, Bratislava

2n = 24 MURÍN, seeds from: SEVA-FLORA Valtice

Previous data and comment

2n = 12 NĚMEC 1910, TJEBBES 1928, NAKAJIMA 1930, NĚMEC 1930, MACCULLAGH 1934, BÖCHER 1940, 1943, COOPER G. O. 1942, DOULAT 1943, DELAY C. 1947, HEISER & WHITAKER 1948, PÓLYA 1948, MATTICK in TISCHLER 1950, BÖCHER et al. 1953, ONO R. 1954, FUJIWARA 1956 LÖVE & LÖVE 1956, Rkahn 1957 (0-1B), CZAPSKA 1959, SOYANO (0-1B) 1959, MULLIGAN 1961, HEISER 1963, LÖVKVIST in WEIMARCK 1963, SORSA V. 1963, GADELLA & KLIPHUIS 1966, RUNEMARK 1967, TAYLOR R. L. in LÖVE 1968, TAYLOR R. L. & MULLIGAN 1968, KUZMANOV & KOZHUHAROV 1969, PODLECH & DIETERLE 1969, BAQUAR & ASKARI 1970, GADELLA & KLIPHUIS 1970, 1971, MURÍN & VÁCHOVÁ in MÁJOVSKÝ et al.1970, DAHLGREN et al. 1971, STRID 1971, FERNANDES A. & FRANCA 1972, FRITSCH R. M. in LÖVE 1973, KOUL & GOHIL 1973, KOZHUHAROV & PETROVA in LÖVE 1974, LÖVE & KJELLQUIST 1074, VAN DEN BRAND in LÖVE 1979, BROWN & JACKSON in LÖVE 1982, DALGAARD 1986, BADR et al. 1987, D'OVIDIO 1984, BADR & KHOLY 1987, SHARMA et al. 1986, MATSUO & NOGUCHI 1989.

2n=4x=24 belongs to artificially induced autotetraploid plants bred in Breeding Station Libochovice and spread to various producers. The tetraploid plants are much bigger with quite good seeds setting. The pollen grains are also bigger e.g. 34,4±0.6 μm versus 29.0±0.8, μm, and their abortion is slightly higher e.g. 21.3%±1.9% versus 16.7% ±1% in diploid plants. It seems to be promising cytotype for further selection, breeding and cultivation.

27. *Rhaponticum orientale* (SERG.)PESCHKOVA

Syn.*Leuzea carthamoides* subsp. *orientalis* Serg.

Present count

2n = 24 MURÍN, seeds from: Bot.Gard.Pharm.Fac.UK, Bratislava

Previous data and comment

2n = 24 SOKOLOVSKAYA & STRELKOVA 1948, ZHUKOVA 1964, 1967, KROGULEVICH 1976.

2n = 26 Rostovceva 1979

Our count is an addition to few previous ones. The other count 2n = 26 is interesting and needs confirmation.

28. *Salvia officinalis* L.

Present count

2n = 14 MURÍN, seeds from: Bot. Gard. Pharm. Fac. UK, Bratislava

Previous data and comment

2n = 14 YAKOVLEVA 1933, HRUBÝ 1934, 1935, SUZAKA & KORIBA 1951, Linnert 1955, BUTTERFASS 1960, MEHRA & GILL 1968, PATUDIN et al. 1975(O-1B), AFZAL-RAFII 1976, GILL 1984, ROSUA & NAVARRO 1986.

Our count 2n = 2x = 14 is a confirmation ot the previous ones.

29. *Salvia sclarea* L.

Present count

2n = 22 MURÍN, seeds from: Bot.Gard.Pharm.Fac.UK, Bratislava

Previous data and comment

2n = 22 SCHEEL 1931, YAKOVLEVA 1933, HRUBÝ 1934, SUZUKA 1950, MARKOVA M. L. 1970, COLOMBO et al. 1980, UHRÍKOVÁ & FERÁKOVÁ 1980, AFZAL-RAFFI 1980, 1981, MARKOVA & IVANOVA 1982, ASTANOVA 1981, DIANA CORRIAS 1983, DIEZ et al. 1984, ROSÚA & BLANCA 1988.

Our count 2n = 2x = 22 falls in line with the previous ones.

30. *Saponaria officinalis* L.

Present count

2n = 28 MURÍN, seeds from: Bot. Gard. Pharm. Fac. UK, Bratislava

Previous data and comment

2n = 28 HEITZ E. 1926, ROCÉN 1926,1927, BLACKBURN 1928, BLACKBURN & BOULT 1930, FAVARGER 1946, PÓLYA 1949, SUZUKA & KORIBA 1949, BLACKBURN & MORTON J. K. 1957, MULLIGAN 1959, LÖVKVIST in WEIMARK 1963, KHOSHOO & BHATIA S. K. 1965, GADELLA & KLIPHUIS 1966, MURÍN & VÁCHOVÁ in MÁJOVSKÝ et al. 1970, FERNANDES A. & LEITAO 1971, PROBATOVA & SOKOLOVSKAYA 1988, BUTLER et al. 1989, HILL et al. 1989.

All the data are the same indicating the tetraploid level for the species (2n = 2x = 28).

31. *Satureja montana* L.

Present count

2n = 30 MURÍN, seeds from: Bot. Gard. Pharm. Fac. UK, Bratislava

Previous data and comment

2n = 30 VAARAMA 1932, LOVKA et al. in LÖVE 1971, PAPEŠ & SILIČ 1981, MARKOVA 1983, AFZAL-RAFII 1985.

Our count is in agreement with the previous ones.

32. *Thymus vulgaris* L.

Present count

2n = 30 MURÍN, seeds from: ROYAL SLUIS

2n = 30 MURÍN, seeds from: DOLMIO Wien

Previous data and comment

2n = 30 VAARAMA 1947, JALAS 1948, MECHELKE 1954, MILOVIDOV & ŠTORCHOVÁ 1958, NATARAJAN 1977, 1978, CARDONA 1978, ROSSELLO 1980, 1981, MORALES VALVERDE 1986.

2n = 56 BONNET 1966

2n = 58 MORALES VALVERDE 1981, 1986.

Both our counts are in agreement with prevailing data, though the other two with 2n=56 and 58 are also interesting, but may be they are a taxonomic misidentifications.

33. *Valeriana angustifolia* TAUSCH

Syn.: *V. collina* WALLR.

Present count

2n = 28 MURÍN, seeds from: ŠÚ Troubsko u Brna (ut *V. officinalis*)

Previous data and comment

2n = 28 MEURMAN 1925, 1931, SENYANINOVA 1927, PRATASENYA 1930, BLACKBURN 1936, SKALIŃSKA 1945, 1946, 1947, PÓLYA 1949, WALTHER E. 1949, SKALIŃSKA 1950, 1958, LAVALRÉE 1952, LÖVE & LÖVE 1956, SÁRKANY & BRANYAI 1958, MEIJERTS 1960, SORSA V. 1962, TITZ W. 1964, 1969, SOKOLOVSKAYA 1970, MURÍN et VÁCHOVÁ in MÁJOVSKÝ et al.1970, LOVKA et al. in LÖVE 1971.

Although the seeds were labelled as *V. officinalis*, our count is in favour of the above given taxon, while the diploid number 2n = 2x = 14 is characteristic for *V. officinalis* s. str. which has been already counted for wild growing plants in Southern Slovakia (MURÍN et FERÁKOVÁ in MÁJOVSKÝ et al. 1974).

34. ***Verbascum densiflorum*** **BERTOL.**
Syn.: *V. thapsiforme* SCHRAD.

Present count
2n = 36 MURÍN, seeds from: SEVA-FLORA Valtice
Previous data and comment
2n = 32 HÅKANSSON 1926, MURÍN in MÁJOVSKÝ et al. 1973
2n = 34 PEEV 1976
2n = 36 MURÍN in MÁJOVSKÝ et al. 1973, SAWICKA in POGAN et al. 1980, POGAN & RYCHLEWSKI 1980

There is some variability in chromosome counts for the species which, however, needs further studies of the three established cytotypes.

Conclusion

Our chromosome counts for 34 species of medicinal and aromatic plants cultivated in Slovakia indicate the following:

1. Most of the species in cultivation remained at the same ploidy level as the native ones.
2. Nevertheless, the present survey revealed some new chromosome counts e. g. *Achilea millefolium* 2n = 81 ± 5, *Agrimonia grandis* 2n = 42, and *Plantago lanceolata* 2n = 24.
3. On the basis of the found chromosome counts some wrong determinations could be corrected e. g. *Echinacea pallida* 2n = 44, *Mentha spicata* 2n = 48, and *Valeriana angustifolia* 2n = 28.
4. The other counts are at least useful addition to karyogeographic and karyotaxonomic data known up to date. They can be applied in further selection and breeding of the medicinal and aromatic plants.

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Because full list of references would enlarge this paper about twice we had to shorten this part and refer to the main Chromosome Number Indexes where the relevant data are included in extenso.

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