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## KARYOSYSTEMATICS STUDY OF SOME ASTERACEAE SPECIES (COMPOSITAE) IN SAUDI ARABIA

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### ABSTRACT

Chromosome numbers were reported for 10 species of family Asteraceae from Saudi Arabia. The new count was reported in *Pulicaria schimperi* L. Karyotype analysis were made for all species, *Conyza bonariensis* (L.) Cronquist  $2n=18$ , *Bidens pilosa* L.,  $2n=70$ , *Pluchea dioscoridis* (L.) DC.  $2n=32$ , *Pulicaria schimperi* L.  $2n=12$ , *Lactuca serriola* L.  $2n=18$ , *Launaea capitata* (Spreng.) Dandy  $2n=18$ , *Launaea resedifolia* (L.) Kuntze  $2n=18$ , *Launaea nudicaulis* (L.) Hook. F.  $2n=18$ , *Reichardia tingitana* (L.) Roth  $2n=16$ , and *Sonchus oleraceus* L.  $2n=32$ , belonging to 4 tribes: Astereae, Heliantheae, Inulea and Lactuceae. *Pulicaria schimperi* L. has the lowest chromosome number ( $2n=12$ ), while the highest number of ( $2n=70$ ) is recorded in *Bidens pilosa* L.

### INTRODUCTION

The family Asteraceae includes over 234 currently accepted species, in 87 genera<sup>[1]</sup>. It is a very large and widespread family of flowering plants in Saudi Arabia, considered the third largest family after Family Poaceae and family Fabaceae<sup>[2]</sup>. The use of chromosomes to solve systematic problems was introduced early and its importance has grown gradually as the nature of chromosomes became understood and as faster and better methods for the study of chromosomes were developed. As a modern discipline, cytology arose with the development of microscopes. Chromosome cytology as an important adjunct to systematic and evolution had come of age.

Such information can be very useful in verifying the integrity of a species and in those instances when species have different chromosome numbers, for providing a reliable character to separate species. This is especially true when chromosomal difference is correlated with morphological variation. However, chromosome counts of Saudi plants. Chromosome counts reported for wild species of Saudi Arabia are very few, <sup>[3-6]</sup>.

The aim of the present study is to find out some cytological characters such as chromosomal criteria (numbers, length, and type) and chromosomal karyotype of some species in Asteraceae.

## MATERIAL & METHODS

The plant species of the Asteraceae (Compositae) were obtained from various habitats in Saudi Arabia. Seeds collected in nature and from herbarium specimens kept in the herbarium of Faculty of Science Imam Abdulrahman bin Faisal University, seeds were germinated in petri dishes. Root tips were collected from 9.00 to 10.00 a.m., pretreated in 0.002 M 8-Hydroxyquinoline solution at 4 ° C for 4-5 hours and fixed overnight in a solution of 1 part 98% acetic acid and 3 parts 96% ethanol. Root tips were hydrolyzed in 5.0N HCl at 20 ° C for 50 min and stained in Feulgen solution for 1.30 -2.00 hours in a dark room at room temperature, squashed in 45% acetic acid. For each plant analyzed, three to five good metaphase plates were selected and photographed using Optical Microscope with a digital camera Model BX53F. SN(3C43813) connected to a computer. Karyotype was drawn using program karyotype 2.0 for Win (build 20181206). The length of chromosome arms is measured paired chromosome lined up according to total size. Karyotype formula was based on the data of chromosome characters. The relative length of each chromosome was calculated by chromosome length/total length of the chromosomes  $\times 100$ <sup>[7]</sup>. Percentage of total form (TF%) = Total length of short arm in a chromosome set / Total length of a chromosome set  $\times 100$ <sup>[8]</sup>.

## RESULTS & DISCUSSION

***Conyza bonariensis* (L.) Cronquist.**  $2n=18$  is shown in FIG-1A, FIG-3.

The present observation of the karyotype of *Conyza bonariensis* ( $2n=18$ ) demonstrate the basic chromosome number  $x=9$ . reported  $n=27$ <sup>[9-13]</sup>, while reported  $n=26$ <sup>[10]</sup>. described  $2n=54$ <sup>[14-17]</sup>. counted  $n=18$ <sup>[18]</sup>. The present count of  $2n=18$  agree with the count stated by<sup>[19]</sup>.

The karyotype includes four chromosome groups the first group consists of two pairs of homologous metacentric long chromosomes, the second group consists of one pair of homologous metacentric satellited chromosomes, the third group include four pairs of asymmetric metacentric chromosomes, the last group has two pairs of submetacentric chromosomes.

***Bidens pilosa* L.**  $2n=70$ , is shown in FIG-1B, FIG-4

This number agreement with one previous data stated<sup>[20]</sup> and oppose a lot of the previous count. This chromosome number is the largest in the taxa under study in the present work. Reported  $2n=36$ <sup>[21]</sup>, described  $2n=48$ <sup>[20,22-24]</sup>; counted two chromosome number in *Bidens pilosa*  $2n=70$  and  $2n=72$ <sup>[20]</sup>; the chromosome number  $2n=72$  had been counted<sup>[21,25-28]</sup>.

Different haploid number  $n=12$  was observed<sup>[29-32]</sup>; while  $n=24$ <sup>[33]</sup> was recorded. The haploid number  $n=36$  was carried out<sup>[34-36]</sup>.

This chromosome number is the largest chromosome number in the taxa under study in the present work. The karyotype consists of five chromosome groups: the first group consists of three pairs of long metacentric chromosomes, the second group consists of twenty-five pairs of medium metacentric chromosome, the third group include two pairs of homologues short metacentric chromosome, the fourth group also include two pairs of very short metacentric chromosomes, while the last (fifth) group contain three pairs of heterogenous<sup>[39-45]</sup>. Different haploid number  $n=12$  was observed<sup>[29,30,31,32]</sup>; while  $n=24$  was recorded by<sup>[33]</sup>. The haploid number  $n=36$  was carried out by<sup>[34,35,46]</sup> and  $n=48$  was described by<sup>[31,32]</sup>.

***Pluchea dioscoridis* (L.) DC.**  $2n=32$ , is shown in FIG-1C, FIG-5.

Only two previous counts had been remarked in *Pluchea dioscoridis*, reported  $n=10$ <sup>[47]</sup> and described  $2n=40$ <sup>[48]</sup> for the Egyptian material, which disagreed with my present count of  $2n=32$ . Chromosomes of Saudi taxa of *Pluchea dioscoridis* have been investigated and which reported  $2n=14$ <sup>[6]</sup>; the present study includes data on *Pluchea dioscoridis*  $2n=32$ . Only two previous counts had been remarked in *Pluchea dioscoridis*, reported  $n=10$ <sup>[47]</sup> and described  $2n=40$  for the Egyptian material<sup>[48]</sup>, which obviously disagree with my present count of  $2n=32$ . Two samples were examined in the present investigation, one from Dammam and the other one from Al-Ahsa. The karyotype from the first locality (Dammam, Khudaria) includes five chromosome groups: the first group consists of one pair of heterogenous metacentric chromosomes, the second group include four pairs of satellited metacentric chromosomes, the third group consists of four pairs of homologous metacentric chromosomes, the fourth group have six pairs of heterogenous metacentric chromosomes, the fifth group include two homogenous sub metacentric satellited chromosomes. The karyotype from the second locality (Al-Ahsa, Al-Oyun) includes five chromosome groups: the first group contains three pairs of long heterogenous metacentric chromosomes, the second group include two pairs of satellited metacentric chromosomes, the third group consists of nine pairs of medium metacentric chromosomes (the first and the sixth pairs are satellite chromosomes), the fourth group comprise one pair of short heterogenous metacentric chromosomes, the fifth group consists of two homogenous sub metacentric satellited sub metacentric chromosomes with average length 2.50 – 3.28  $\mu\text{m}$ .

***Pulicaria schimperi* L.**  $2n=12$ , is shown in FIG-1D, FIG-5

The genus *Pulicaria* comprises c. 40 species known from Eurasia and Africa<sup>[49,50]</sup>. Eleven species occur in Saudi Arabia, the present new count of  $2n=12$  has not previously been reported and is the first count for this species. Noprevious count had been done on *Pulicaria schimperi* from Saudi Arabia. The karyotype of this species includes three chromosome groups: the first group consists of two pairs of metacentric satellited chromosomes, the second group comprises three pairs of metacentric chromosomes, and third group contain one pair of sub metacentric chromosomes.

***Lactuca serriola* L.**  $2n=18$ , is shown in FIG-1E, FIG-5

Three samples were examined in the present investigation, one from Dammam, Industrial area, the second from Dammam, Khudaria and the last seed sample from Al-Ahsa, Al-Oyun. The karyotype from the first locality (Dammam, Industrial area) includes five chromosome groups characterized by the following parameters: the first group consistsof two pairs of heterogenous metacentric chromosomes with total average length 1.50 - 2.18  $\mu\text{m}$ , the second group include one pair of long sub telocentric chromosomes with a total average length of 2.58 - 3.00  $\mu\text{m}$ , the third group comprises four pair of heterogenous medium sub metacentric chromosomes (the first pair of this group is satellited) with total average length 1.76 - 2.43  $\mu\text{m}$ , the fourth group in this karyotypeincluded one pair of short homologous sub metacentric chromosomes with an average length 1.48 - 1.49  $\mu\text{m}$ , while the last group (fifth group) include one pair of heterogenous sub telocentric chromosomes with an average length 2.18 - 3.00  $\mu\text{m}$ . The karyotype from the second locality (Dammam, Khudaria) includes four chromosome groups characterized by the following parameters: the first group consists of two pairsof heterogenous metacentric chromosomes with a total average length on 2.28 - 2.56  $\mu\text{m}$ , the second group consists of three pairs of long heterogenous sub metacentric chromosomes with total average length 2.98 - 4.25  $\mu\text{m}$ , the third group comprises three pairs of heterogenous medium sub metacentric chromosomes (the first pair of this groupis satellited) with total average length 2.17 - 2.67  $\mu\text{m}$ , the fourth group in this karyotypeinclude one pair of heterogenous sub telocentric chromosomes with an average length

3.36 - 3.40  $\mu\text{m}$ . The karyotype from the third locality (Al-Ahsa, Al-Oyun) includes four chromosome groups characterized by the following parameters: the first group consists of two pairs of heterogenous metacentric chromosomes with total average length 2.29 - 2.95  $\mu\text{m}$ , the second group consists of two pairs of long heterogenous sub metacentric chromosomes (the first pair of this group is satellited) with total average length 3.95 - 4.45  $\mu\text{m}$ , the third group comprises four pairs of heterogenous medium sub metacentric chromosomes with total average length 2.07 - 3.43  $\mu\text{m}$ , the fourth group in this karyotype include one pair of heterogenous sub telocentric chromosomes with an average length 3.53 - 3.74  $\mu\text{m}$ .

***Launaea (capitata (Spreng.) Dandy.***  $2n=18$  is shown in FIG-1F, FIG-6 ***nudicaulis (L.) Hook.***  $F.2n=18$  is FIG-2G, FIG-6 ***resedifolia (L.) Kuntze.***  $2n=18$ , FIG-2H, FIG-7.

Chromosomes of Saudi taxa of *L. capitata* have been investigated before by  $2n=18^{[6]}$ ; the present study includes data on three taxa of *Launaea*, *L. capitata*  $2n=18$ , *L. nudicaulis*,  $2n=18$  and *L. resedifolia*  $2n=18$ . The chromosome count  $2n=18$  had been counted by detected polyploid number  $2n=32^{[51,52]}$  and  $2n=18^{[6]}$ . Also, the haploid number  $n=9$  which had been observed by  $^{[53,13]}$ , all previous counts agree the present count  $2n=18$ . A few previous counts had been done on *Launaea resedifolia* from Saudi Arabia material. The present chromosome count of  $2n=18$  agreed with the count observed  $^{[54]}$ . Which was carried by  $^{[55,52]}$  and varied from the count  $n=8$ , which was previously counted  $^{[13]}$ . The Karyotype of *L. capitata* characterized by three main groups, the first one includes three pairs of long metacentric chromosomes, the medium metacentric chromosomes were observed in the second group which contain three pairs of chromosomes, the last (third) group also contained three pairs but submetacentric main groups, the first one includes three pairs of long satellited metacentric chromosomes, the second group have five pairs of metacentric chromosomes, the third group contain only one homologous pair of metacentric chromosomes having the same length.

The karyotype of *Launaea resedifolia* includes four chromosome groups characterized by the following parameters: the first group consists of one pair of long metacentric satellited chromosomes, the second group consists of three long metacentric chromosome pairs, the third group include three pairs of medium metacentric chromosomes and two pairs of short metacentric chromosomes was obtained in the last fourth group in this karyotype.

***Reichardia tingitana (L.) Roth.***  $2n=16$  is shown in FIG-2I, FIG-7

The chromosome count  $2n=16$  had been counted by a lot of researchers  $^{[56-62,51,63,52]}$ . Three samples of *Reichardia tingitana* (L.) Roth was examined in the present investigation, two from Gazan, (Abu Arish and Jabal manjed), and the third one from Hafar Al-Batin. The Mean karyotype includes four chromosome groups, the first group consists of two pairs of heterogenous long metacentric satellited chromosomes with a total average length 2.34 – 2.81  $\mu\text{m}$ , the second group comprise three pairs of heterogenous (long to medium) metacentric chromosomes with total average length 1.57 – 2.23  $\mu\text{m}$ , the third group include two relatively short metacentric chromosomes with a total average length 1.33 – 1.45  $\mu\text{m}$  and the last group consists of four long submetacentric chromosomes with total average length 1.88 – 2.15  $\mu\text{m}$ .

***Sonchus oleraceus L.***  $2n=32$  is shown in FIG-2J, FIG-7

The chromosome count  $2n=32$  had been counted by a lot of researchers  $^{[64-86,61,87,88,51,63,89,52,6,90,87]}$ , all these previous counts agree with the present investigation  $2n=32$ .

The haploid number,  $n=16$  which observed<sup>[91,92,93,12,13,36,33,94]</sup>, also decide the present observation  $2n=32$ . Variation of haploid number,  $n=18$ <sup>[95,36]</sup>,  $n=16$ <sup>[18]</sup>,  $n=10$ <sup>[96]</sup>, and  $n=9$ <sup>[21]</sup>, with disagreed the present investigation.

Chromosomes of Saudi taxa of *Sonchus oleraceus* L. have been investigated by<sup>[6]</sup> which reported  $2n=16$ ; the present study includes data on *Sonchus oleraceus*  $2n=32$ . The present work shows that *Sonchus oleraceus* ( $2n=32$ ) showing basic numbers  $x=8$  for this species, and the present count agree with all previous counts. The chromosome count  $2n=32$  had been counted by a lot of researchers all these previous counts agree with the present investigation  $2n=32$ . Chromosomes of Saudi taxa of *Sonchus oleraceus* L. have been investigated by<sup>[6]</sup> which reported  $2n=16$ ; the present study includes data on *Sonchus oleraceus*  $2n=32$ . The karyotype consists of four main groups: the first group include three pairs of heterogenous long metacentric chromosomes, the second group contain nine pairs of medium metacentric chromosomes, the third group has two heterogenous large sub metacentric chromosomes, the last group includes three pairs of medium sub metacentric chromosomes.

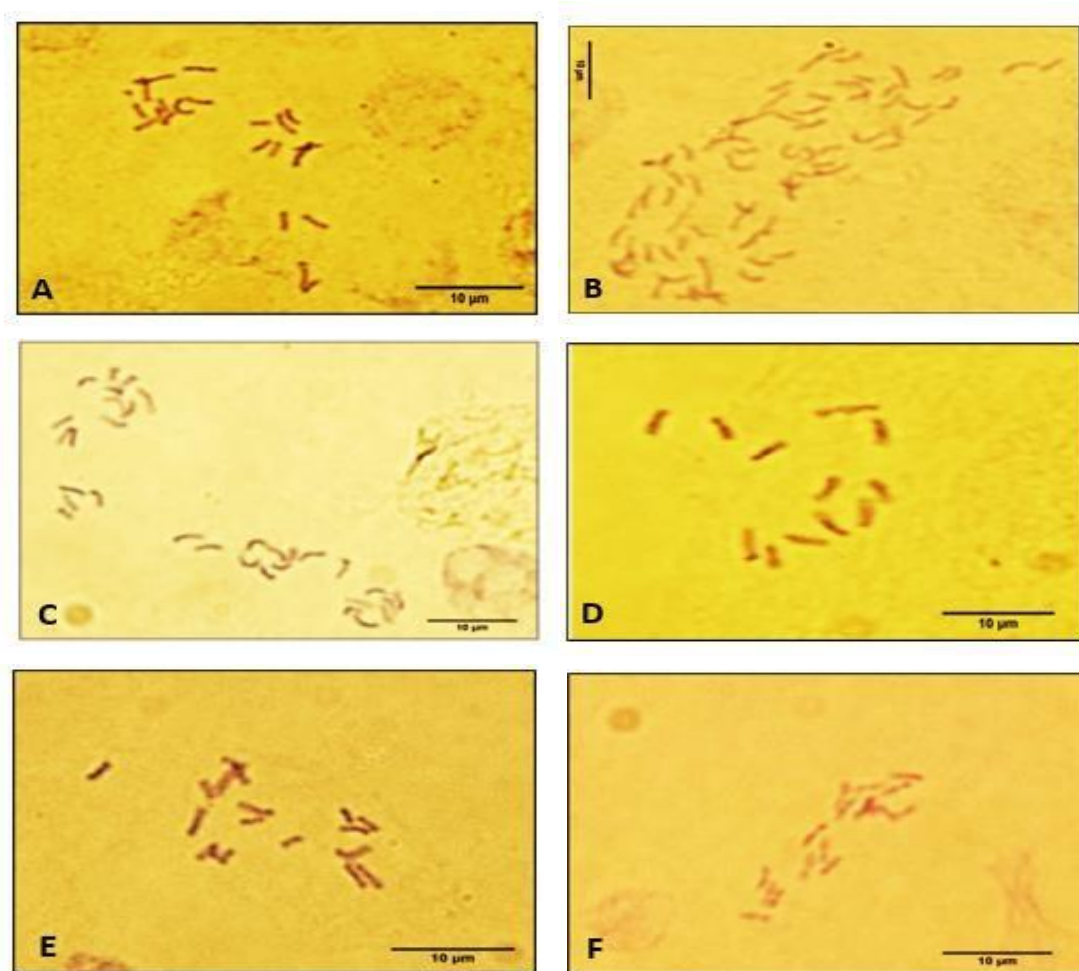


FIG-1. Metaphase plates, A. *Conyza bonariensis*, B. *Bidens pilosa*, C. *Pluchedioscoridis*, D. *Pulicaria schimperi*, E. *Lactuca serriola*, F. *Launaea capitata*.

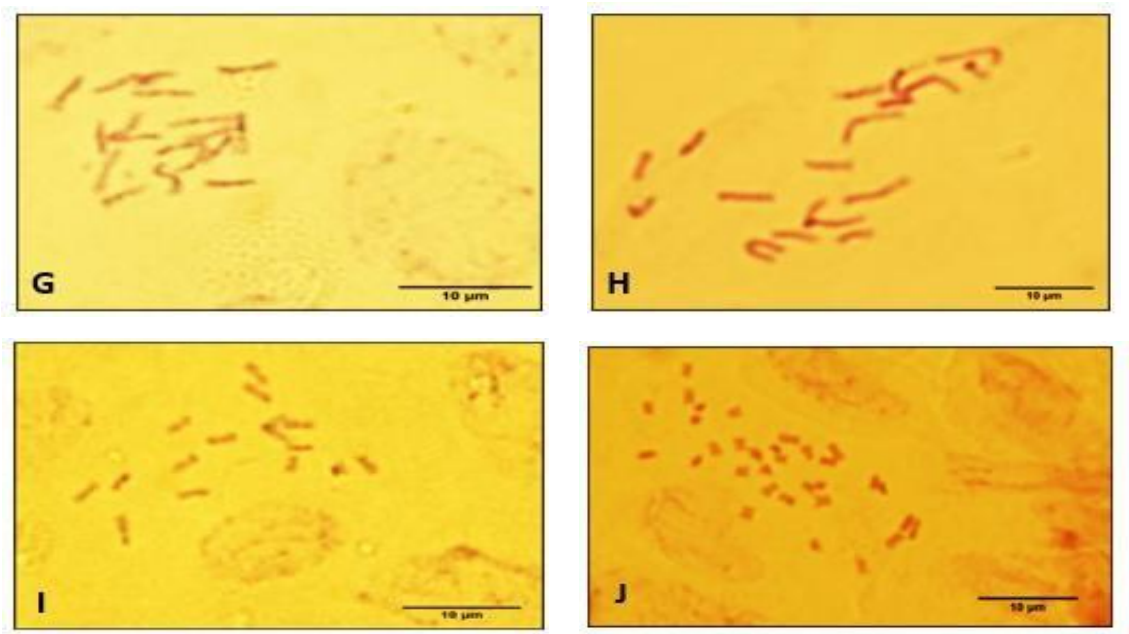


FIG-2. G. *Launaea nudicaulis*, H. *Launaea resedifolia*, I. *Reichardia tingitana*, J. *Sonchus oleraceus*

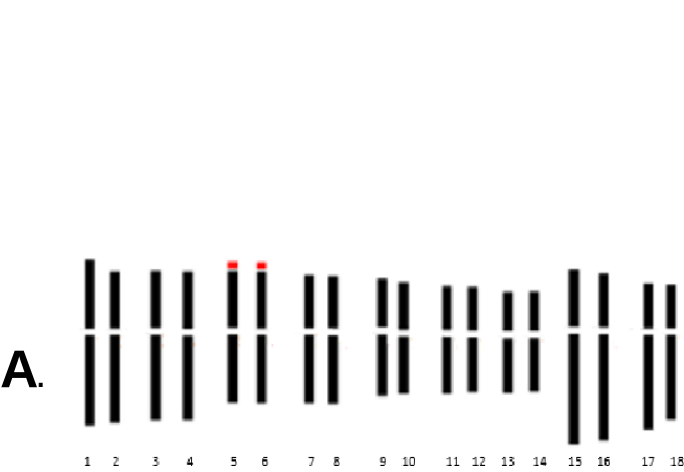


FIG-3. Ideograms of chromosomes A: *Conyza bonariensis*.

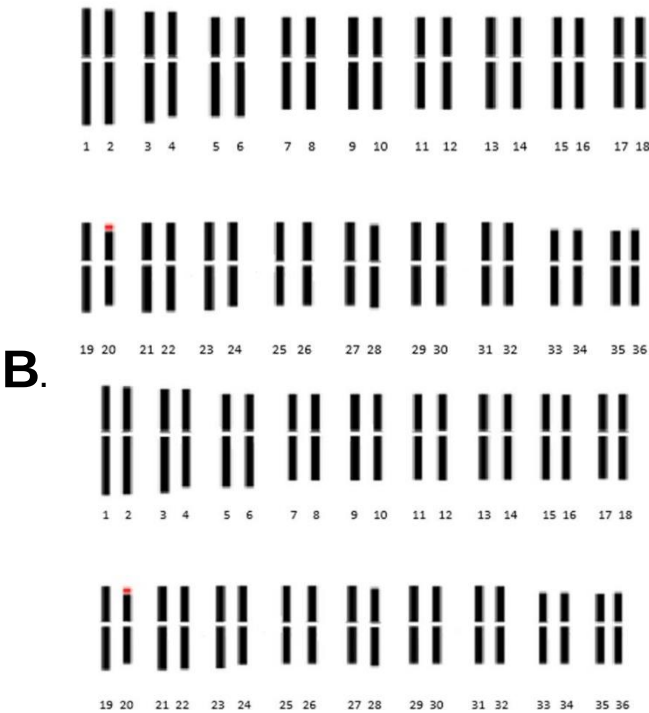


FIG-4. Ideograms of chromosomes B: *Bidens Pilosa*.

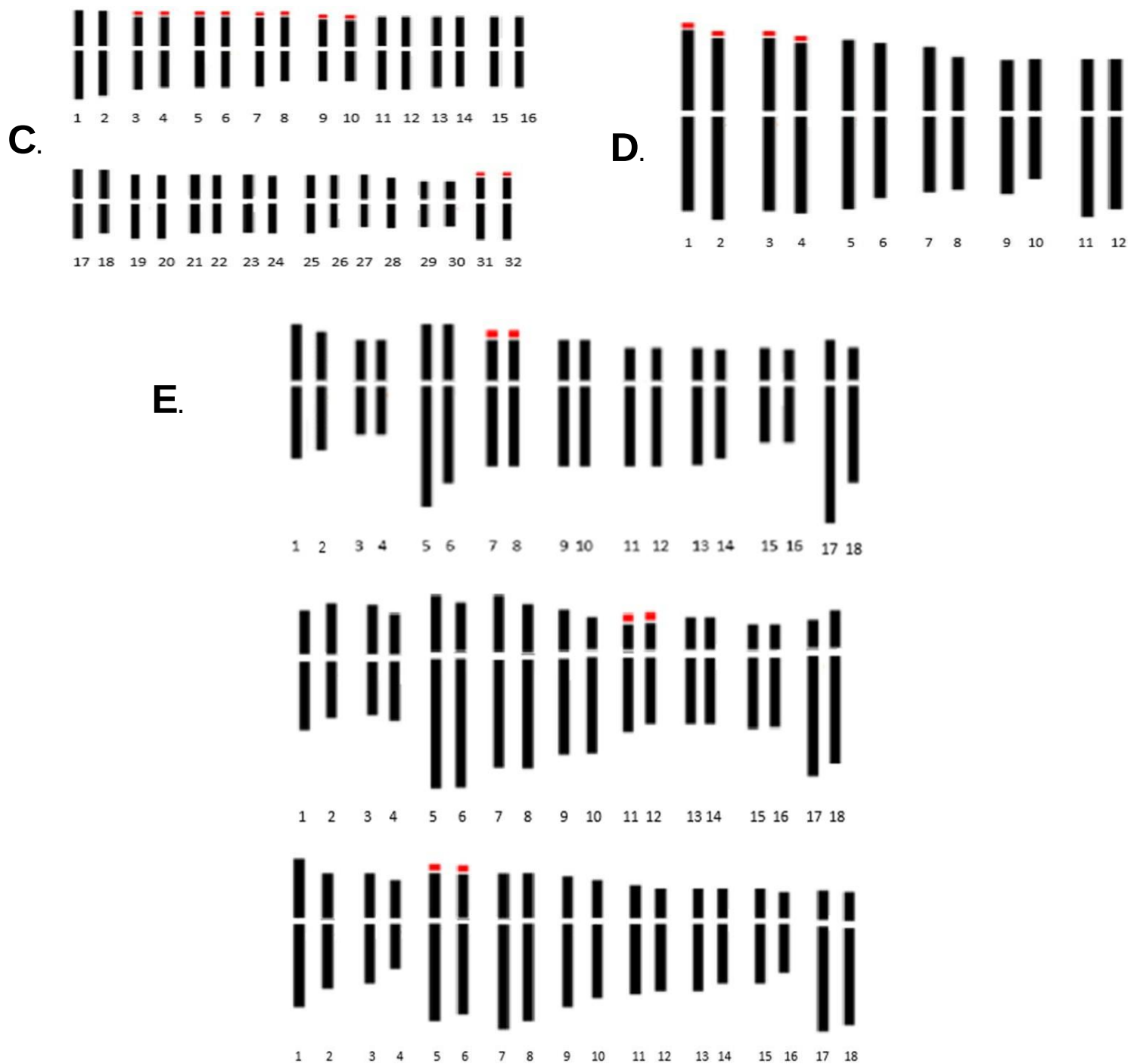


FIG-5. Ideograms of chromosomes C: *Pluchea dioscoridis*, D: *Pulicaria schimperi*, E: *Lactuca serriola* (Dammam,Industrial area & Dammam, Khudaria and Al-Ahsa, Al-Oyun area).

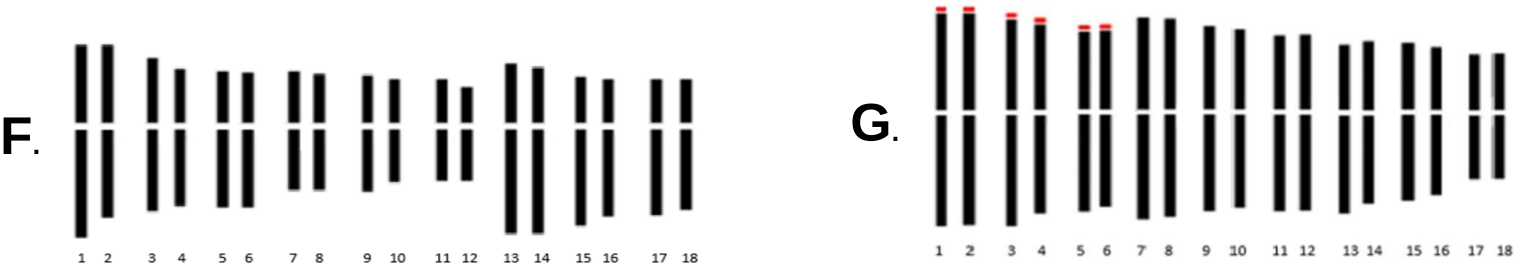


FIG-6. Ideograms of chromosomes F: *Launaea capitata*, G: *Launaea nudicaulis*.

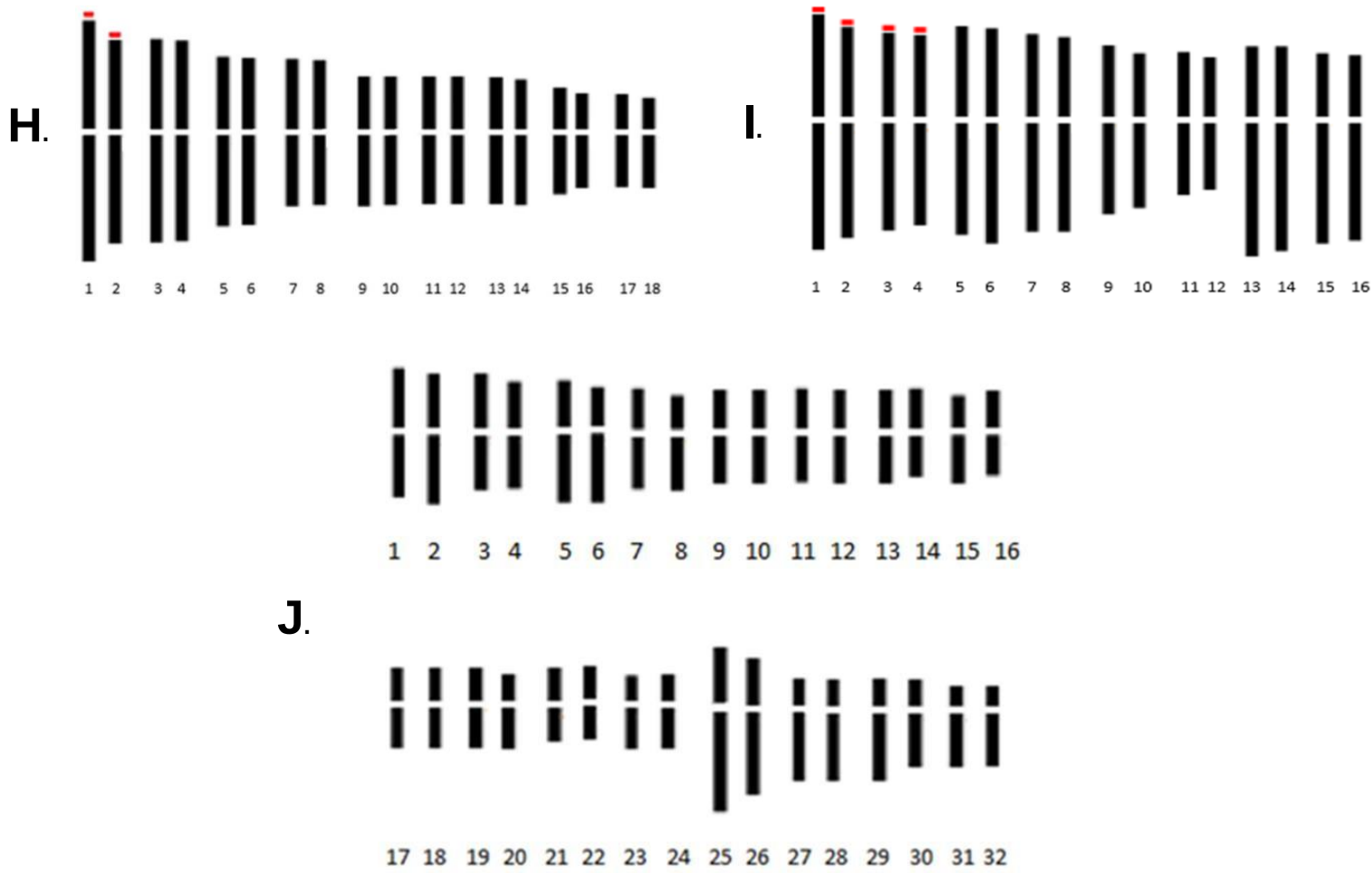


FIG-7. Ideograms of chromosomes H: *Launaea resedifolia*, I: *Reichardia tingitana*, J: *Sonchus oleraceus*.

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## BIBLIOGRAPHY:

- 1 - Chaudhary, S.A. (2000). Flora of the Kingdom of Saudi Arabia. Ministry of Agriculture and Water.P117.
- 2 - Mandaville, J. P., & Mandaville, J. P. (1990). Flora of Eastern Saudi Arabia (p. 482). London: Kegan Paul International.
- 3 - Badr A, Gasim A. (1992). Chromosomal studies on some plants in the flora of Madinah region. – J. King Abdul Aziz Univ. 4: 23-35.
- 4 - Turki A. Al-Turki, Shafik A. Filfilan & Syed F. Mehmood. (2000). A Cytological study of flowering plants from Saudi Arabiam ,Willdenowia ,30, 339-358.
- 5 - Sharawy SM, Kamel EA, Karakish EA, Loutfy MH. (2015). A systematic revision on Caralluma species of Saudi Arabia based on karyological and molecular data, Pakistan J. Bot.,47(3), 937- 950.
- 6 - Sameer H Qari , Ehab A. Kamel And Khaled S. Ali. (2016). Karyotype Criteria of Some Taxa Of Asteraceae (Compositae) From Saudi Arabia, 5(11): 2956-2966.
- 7 - Levan, L. Fredga, K. and Sanberg, A.A. (1964). Nomenclature for centromeric position of chromosome. Hereditas, 52: 201-220.
- 8 - Huziwaru Y. (1962). Karyotype analysis in some genera of Compositae. VIII. Further studies on the chromosome of Aster. American Journal of Botany 49: 116-119.
- 9 - Turner, B. L., Bacon, J., Urbatsch, L., & Simpson, B. (1979). Chromosome numbers in south American Compositae. *American Journal of Botany*, 66(2), 173-178.
- 10 - Jansen, R. K., Stuessy, T. F., Diaz-Piedrahita, S., & Funk, V. A. (1984). Recuentos cromosómicos en Compositae de Colombia. *Caldasia*, 7-20.
- 11 - Bernardello, L. M. (1986). Números cromosómicos en Asteraceae de Córdoba. *Darwiniana*, 169-178.
- 12 - Razaq, Z. A., Khatoon, S., & Ali, S. I. (1988). Compositae From Pakistan. *Pak. J. Bot*, 20(2), 177-189.
- 13 - Razaq, Z. A., Vahidy, A. A., & Ali, S. I. (1994). Chromosome numbers in Compositae from Pakistan. *Annals of the Missouri Botanical Garden*, 800-808.
- 14 - Strid, A. & R. Franzen. (1981). In Chromosome number reports LXXIII. *Taxon* 30: 829–842.
- 15 - Buttler, K. P. (1984). Chromosomenzahlen von Gefasspflanzen aus Hessen (und dem angrenzenden Bayern), 2. Folge. *Hess. Florist. Briefe* 33: 46–48.
- 16 - Urdampilleta, J., Amat, A., & Bidau, C. (2005). Karyotypic studies and morphological analysis of some reproductive features in five species of Conyza (Astereae: Astereceae) from northeastern Argentina. *Bol Soc Arg Bot*, 40, 91-99.
- 17- Baltisberger. (2006). IAPT/IOPB chromosome data 1. *Taxon* 55(2): 444.

- 18 - Carr, G. D., King, R. M., Powell, A. M., & Robinson, H. (1999). Chromosome numbers in Compositae. XVIII. *American Journal of Botany*, 86(7), 1003-1013.
- 19 - Wulff, A. F. (1998). Estudios cariologicos en Asteraceae. VIII. *Darwiniana*, 37-43.
- 20 - Mariano, A. C. & M. A. Marin-Morales. (1999). Chromosome polymorphism and cytotype establishment in *Bidens pilosa* (Asteraceae). *Cytobios* 97: 45–60.
- 21 - Sharma, A. K. (1970). Annual report, 1967-1968. Res. Bull. Univ. Calcutta Cytogenetics Lab. 2: 1–50.
- 22 - Pilz, G. E. (1980). In Chromosome number reports LXVII. *Taxon* 29: 352–353.
- 23 - Nirmala, A. & P. N. Rao. (1984). Karyotype studies in Asteraceae. *Cell Chromosome Res.* 7: 26–28.
- 24 - Morton, J. K. (1993). Chromosome numbers and polyploidy in the flora of Cameroon Mountain. *Opera Bot.* 121: 159–172.
- 25 - Banerjee, A. K. (1971). Cytological investigations on some Indian members of the tribe Helianthoideae (Family – Compositae). *J. Cytol. Genet.* 6: 90–109.
- 26 - Gadella, T. W. J. (1977). In IOPB chromosome number reports LVI. *Taxon* 26: 257–274.
- 27 - Nirmala, A. & P. N. Rao. (1981). In Chromosome number reports LXX. *Taxon* 30: 78.
- 28 - Gadella, T. W. (1982). In: IOPB chromosome number reports LXXVI. *Taxon* 31: 595–596.
- 29 - Keil, D. J. & T. F. Stuessy. (1977). Chromosome counts of Compositae from Mexico and the United States. *Amer. J. Bot.* 64: 791–798.
- 30 - Gill, L. S. (1978). Chromosome numbers of angiosperms in Tanzania: II. *Adansonia* 18: 19–24
- 31 - Gill, L. S. (1978). In IOPB chromosome number reports LX. *Taxon* 27: 223–231
- 32 - Gill, L. S. & I. D. Omoigui. (1988). Cytomorphology of the tribe Heliantheae (Asteraceae) from southern Nigeria. *Feddes Repert.* 99: 1–13.
- 33 - Husaini, S. W. H. & G. A. Iwo. (1990). Cytology of some weedy species of the family Compositae (Asteraceae) from Jos Plateau, Nigeria. *Feddes Repert.* 101: 49–62.
- 34 - Robinson, H. E., A. M. Powell, R. M. King & J. F. Weedin. (1981). Chromosome Numbers in Compositae, XII: Heliantheae. *Smithsonian Contr. Bot.* 52: 1–28.
- 35 - Aparicio, A. & S. Silvestre. (1985). Numeros cromosomicos para la flora Española, 422–434. *Lagascalia* 13: 318–323.
- 36 - Gupta, R. C. & B. S. Gill. (1989). Cytopalynology of north and central Indian Compositae. *J. Cytol. Genet.* 24: 96–105.
- 37 - Gill, L. S. & I. D. Omoigui. (1987). The incidence of polyploidy in family Asteraceae in southern Nigeria. *Rev. Cytol. Biol. Veg., Bot.* 10: 177–184.
- 38 - Gill, L. S. & I. D. Omoigui. (1988). Cytomorphology of the tribe Heliantheae (Asteraceae) from southern Nigeria. *Feddes Repert.* 99: 1–13.

- 39 - Podlech, D. (1986). Chromosomenstudien en Pflanzen des Saharo-Sindischen Trockengebietes. Mitt. Bot. Staatssamml. München 22: 5–20.
- 40 - Baltisberger, M. (1990). Chromosome numbers of some plants from Papua New Guinea. Bot. Helv. 100: 97–100.
- 41 - Zhao, Z. f., Y. q. Wang & S. f. Huang. (1990). Plant chromosome counts (V). Forest Res. (China) 3: 503–508.
- 42 – Plante, S. (2000). Documentation chromosomique. Contribution no 3. Ludoviciana 29: 81–82.
- 43 - Molero, J., A. Rovira, J. Simón, R. Dure & D. Franco. (2002). IOPB chromosome data 18. Newslett. Int. Organ. Pl. Biosyst. (Pruhonice) 34: 22–24.
- 44 - Xie, Z. y. & C. m. Zheng. (2003). Cytological studies on 13 species of Compositae from Hainan, China. Acta Phytotax. Sin. 41(6): 545–552.
- 45 - Grombone-Guaratini. (2006). Chromosomal studies of three species of *Bidens* (L.) (Asteraceae). Caryologia 59(1): 14–18.
- 46 - Gupta, R. C., B. S. Gill & R. K. Garg. (1989). Chromosomal conspectus of western Himalayan Compositae. Aspects Pl. Sci. 11: 427–437.
- 47 - Gill, L. S. & A. M. Abubakar. (1975). In IOPB chromosome number reports XLVIII. Taxon 24: 367–372.
- 48 - Badr, A., E. A. Kamel & N. Garcia-Jucas. (1997). Chromosomal studies in the Egyptian Flora VI. Karyotype features of some species in subfamily Asteroideae (Asteraceae). Compositae Newslett. 30: 15–28.
- 49 - Merxmüller, H. & Grau, J. (1977). Fruchtanatomische Untersuchungen in der *Inula*-Gruppe (Asteraceae). Publ.CairoUniv.Herb.7/8: 9-20
- 50 - Gamal-Eldin, E. (1981). Revision der Gattung *Pulicaria* (Compositae – Inuleae) für Afrika, Makaronesien und Arabien. – Phanerog. Monogr. 14
- 51 - Malallah, G. A. & G. Brown. (1999). Determination of chromosome number of Kuwaiti flora I. Cytologia 64: 181–196.
- 52 - Kamel. (2004). Cytotaxonomical investigations of the Egyptian Compositae (Asteraceae): I-Cardueae and Cichorieae. Compositae Newslett. 41: 9–28.
- 53 - Amin, A. (1973). Cytological studies on some Egyptian plants. United Arab Republic J. Bot. 16: 501–506.
- 54 - Valdes-Bermejo, E. & J. G. GARCIA. (1976). Notas cariosistematicas sobre flora espanola. I. Acta Bot. Malac. 2: 39–50.
- 55 - Brullo, S., G. MAJORANA, P. Pavone & M. C. TERRASI. (1977). Numeri cromosomici per la flora Italiana: 283-298. Inform. Bot. Ital. 9: 40–55.
- 56 - Humphries, C. J., B. G. Murray, G. Bocquet & K. N. Vasudevan. (1978). Chromosome numbers of phanerogams from Morocco and Algeria. Bot. Not. 131: 391–404.
- 57- Snogerup, B. (1980). The genus *Reichardia* (Asteraceae) in the Aegean area. Bot. Not. 133: 515–520.
- 58 - Gallego, M. J. (1980). Estudio cariologico de las especies espaholas del genero *Reichardia* Roth (Compositae). Lagasalia 9:149–158.
- 59 - Siljak-yakovlev, S. (1982). In IOPB chromosome number reports LXXVII. Taxon 31: 768.

- 60 - Siljak-yakovlev, S. (1996). La dysploidie et levolution du caryotype. *Boccone* 5: 211–220.
- 61 - Oberprieler, C. & R. Vogt. (1993). Chromosome numbers of north African phanerogams. II. *Willdenowia* 23: 211–238.
- 62 - Mejias, J. A. (1998). Mediterranean chromosome number reports 8 (936–940). *Fl. Medit.* 8: 245–251.
- 63 - Vogt, R. & A. Aparicio. (1999). Chromosome numbers of plants collected during lter Mediterraneum IV in Cyprus. *Boccone* 11: 117–169
- 64 - Nazarova, E. A. (1975). Chromosome numbers of some species of Armenian flora. *Biol. Zurn. Armen.* 28(1): 95–97.
- 65 - Nazarova, E. A. (1984). Chromosome numbers in the Caucasian representatives of the families Asteraceae, Brassicaceae, Fabaceae, Limoniaceae. *Bot. Zhurn. SSSR* 69(7): 972–975. (In Russian).
- 66 - Nazarova, E. A. (1989). Karyological and palynological study of representatives of the genus *Sonchus* from the Caucasus. *Bot. Zhurn. (Moscow & Leningrad)* 74: 53–59.
- 67 - Peng, C. i. & C. c. Hsu. (1977). In IOPB chromosome number reports LVIII. *Taxon* 26: 557–565.
- 68 - Peng, C. i. & C. c. Hsu. (1978). Chromosome numbers in Taiwan Compositae. *Bot. Bull. Acad. Sin.* 19: 53–66.
- 69 - Sidhu, M. K. (1979). Distributional and cytological studies of the weed flora of cultivable fields of Patiala district (Panjab). Ph.D. Thesis, Patiala. 1-230. 1979.
- 70 - Kliphuis, E. & J. H. Wieffering. (1979). In Iopb Chromosome Number Reports Lxiv. *Taxon* 28:398–400.
- 71 - Bir, S. S. & M. Sidhu. (1979). Cytological observations in weed flora of orchards of Paticla district, Punjab. *Recent Res. Pl. Sci. (New Delhi)*. 7: 261–271.
- 72 - Bir, S. S. & M. Sidhu. (1980). Cyto-palynological studies on weed flora of cultivable lands of Patiala district (Punjab). *J. Palynol.* 16: 85–105
- 73 - Van Loon, J. C. (1980). In Chromosome number reports LXIX. *Taxon* 29: 718–720.
- 74 - Jansen, R. K. & T. F. Stuessy. (1980). Chromosome counts of compositae from Latin America. *Amer. J. Bot.* 76: 585–594.
- 75 - Arohonka, T. (1982). Chromosome counts of vascular plants of the island Seili in Nauvo, southwestern Finland. *Ann. Univ. Turku., Ser. A, Biol.-Geogr.* 3: 1–12.
- 76 - Nishikawa, T. (1984). Chromosome counts of flowering plants of Hokkaido (7). *J. Hokkaido Univ. Educ., Sect. 2B* 35: 31–42.
- 77 - Hiremath, B. S. & M. S. Chennaveeraiah. (1985). Cytological studies in *Sonchus oleraceous* Linn. *Proc. Indian Acad. Sci., Pl. Sci.* 95: 373–377.
- 78 - Guerra, M. d. S. (1986). Citogenetica de Angiospermas coletadas en Pernambuco, I. *Revista Brasil. Genet.* 9: 21–40.
- 79 - Mathew, A. & P. M. Mathew. (1988). Cytological studies on the south Indian Compositae. *Glimpses Pl. Res.* 8: 1–177.
- 80 - Parfenov, V. I. & S. A. Dmitrieva. (1988). Kariologicheskaja kharakteristika predstavitelej flory sosudistyxh rastenij Berezinskogo biosfernogo zapovednika. *Zapov. Belorussii Issl.* 12: 3–8.
- 81 - Lavrenko, A. N. & N. P. Serditov. (1991). Chromosome numbers in some plant species from the south-west of the Komi ASSR. *Bot. Zhurn. (Moscow & Leningrad)* 76: 769–771.
- 82 - Kiehn, M., E. Vitek, E. Hellmayr, J. Walter, J. Tschenett, C. Justin & M. Mann. (1991). Beitrage zur Flora von Osterreich: Chromosomenzahlungen. *Verh. Zool.-Bot. Ges. Wien* 128: 19–39.
- 83 - Pangua, E., C. Prada, S. Pajaron & E. Salvo. (1992). A new *Asplenium* hybrid from Valencia (Spain) related to *A. majoricum* Litard. *Bot. J. Linn. Soc.* 108(1): 1–13.

- 84 - Xu, B. s., R. f. Weng & M. z. Zhang. (1992). Chromosome numbers of Shanghai plants I. Invest. Stud. Nat. 12: 48–65.
- 85 - Diaz Lifante, Z., T. Luque & C. S. Bárbara. (1992). Chromosome numbers of plants collected during Iter Mediterraneum II in Israel. *Bocconeia* 3: 229–250.
- 86 – Al-Bermani, A. K. K. A., Al-Shammary, K. I. A. Gornall, R. J., & Bailey, J. P. (1993). Contribution to a cytological catalogue of the British and Irish flora, 3. *Watsonia* 19: 169–171.
- 87- Probatova, N. S., E. G. Rudyka & A. P. Sokolovskaya. (1996). Chromosome numbers in synanthropic plants from the Russian Far East. *Bot. Zhurn. (Moscow & Leningrad)* 81(5): 98–101.
- 88 - Albers, F. (1998). In R. Wisskirchen & H. Haeupler, *Standardliste der Farn- und Blütenpflanzen Deutschlands*. Bundesamt für Naturschutz & Verlag Eugen Ulmer, Stuttgart.
- 89 - Lovkvist, B. & U. M. Hultgard. (1999). Chromosome numbers in south Swedish vascular plants. *Opera Bot.* 137: 1–42.
- 90 - Gemeinholzer. (2005). New chromosome counts for some Lactuceae (Compositae). *Compositae Newslett.* 42: 43–46.
- 91 - Koul, A. K., A. K. Wakhlu & J. L. Karihaloo. (1976). Chromosome numbers of some flowering plants of Jammu (western Himalayas). II. *CIS Chromosome Inform. Serv.* 20: 32–33.
- 92 - Tomb, A. S., K. L. Chambers, D. W. KYHOS, A. M. Powell & P. H. RAVEN. (1978). Chromosome numbers in the Compositae XIV. Lactuceae. *Amer. J. Bot.* 65: 717–721.
- 93 - Gallego Cidoncha, M. Jm, (1985). Numeros 404-408, in *Numeros cromosomicos para la flora espanola*. 363-434. *Lagascalia* 13: 311–313.
- 94 - Gill, L. S. & D. I. Omoigui. (1992). Chromosome numbers in some Nigerian Compositae. *Compositae Newslett.* 20/21: 12–15.
- 95 - Gupta, R. C. & R. K. Garg. (1987). SOCGI plant chromosome number reports -- IV [i.e., V]. *J. Cytol. Genet.* 22: 162–163.
- 96 - Sun, B. y., M. R. Sul, J. A. Im, C. H. Kim & T. J. Kim. (2002). Evolution of endemic vascular plants of Ulleungdo and Dokdo in Korea--floristic and cytotaxonomic characteristics of vascular flora of Dokdo. *Korean J. Pl. Taxon.* 32: 143–158.
- 97 - Mohamed, M.K. (1990). *Karyosystematic Studies on Compositae – Lactuceae (=Cichorieae) of Egypt*. El-Minia Univ. (Egypt). Faculty of Science.
- 98 - Mohamed, M.K. (1997). Chromosome counts in some flowering plants from Egypt. *Minia Univ. (Egypt). Faculty of Science. J. Bot.* 37, No. 2, pp. 129-156.
- 99 - Mohamed, M.K. (1998). Chromosome number of some *carex* species. *J. Union Arab Biol. Cairo. Vol. 6(B), Botany*, 153-161.
- 100 - Mohamed, M.K. (1998). Cytotaxonomic study on *reichardia tingitana* (L.) roth in Egypt. *J. Union Arab Biol. Cairo. Vol. 5(B), Botany*, 121-136



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