



Chromosome number of some medicinal angiosperms: A review article

Rai Singh*, Ramneet Kaur, Tanisha

Biology Lab, S. S. B. P. Khalsa Senior Secondary School, Faridkot, Punjab, India

Corresponding Author: Email-raibot95@gmail.com

Abstract

A total of thirty four (34) Angiosperm species belonging to 27 genera and 9 families are selected for compilation of chromosome number. Chromosome number and ploidy shows great variations from species to species. Some species have different genera as well as family but chromosome number is same. These chromosomal changes provides information about the evolutionary behaviour of the species.

Keywords: Chromosome, genetics, medicine, gene, angiosperm, plant

Introduction

Angiosperms are seed bearing plants distributed all over the world with 2, 95,383 species (Christenhusz and Byng, 2016)^[13]. They fulfil basic needs of human beings and other life forms in the form of food, fodder, shelter, medicine etc. (Singh and Sidhu, 2022)^[55].

Large number of methods practised by scientists for identification of plants. Chromosome number is basic tool and considered for authentication of species after morphological studies. According to Raven (1975)^[45] different species under same genus have great variation in chromosome number. Therefore chromosome number of species are studied in different parts of the world as a taxonomic tool.

Keeping this in view, chromosome number of some species, especially medicinal plants are compiled from the literature. This study will be helpful for cytologists, researchers, botanists etc. as a database of chromosomal details of medicinal angiosperms.

Material and Methods

Information about chromosome number of 34 angiosperm species is recorded from available literature (research papers, dissertations, atlas etc). Chromosome number of these species were studied by researchers from India and different parts of the world. Presently, data is represented with botanical name, family and chromosome number of the species.

Results and Discussion

Chromosome number of 34 angiosperm species belonging to 27 genera and 9 families are collected from the available literature (Table.1.). These chromosome numbers are worked by scientists time to time in different parts of the world. Out of 34 species, 15 species belonging to family Asteraceae and this family acts as a dominant family. Family Solanaceae represented with 9 species followed by Convolvulaceae, Euphorbiaceae and Malvaceae with 2 species each, Cannabaceae, Fabaceae, Fumariaceae, Lamiaceae with one species each. *Solanum* acts as dominant genera with 4 species followed by *Sonchus* with 3 species and *Sida* and *Launaea* with 2 species each.

Chromosome number of species ranges from $2n = 12$ to $2n=72$. Some species shows variations in chromosome number such as *Ageratum conyzoides* (L.) L. ($2n= 20, 30, 40$), *Calendula officinalis* L. (14, 28, 32), *Sonchus oleraceus* (L.) L. (16, 32), *Convolvulus arvensis* L. ($2n= 32, 48, 50$) and *Withania somnifera* (L.) Dunal ($2n= 48, 72$). *Sonchus asper*, *Sonchus oleraceus* and *Sonchus wightianus* are the member of same genera (*Sonchus*) but great variation in chromosome number and nature of ploidy. Similarly, species of genus *Solanum* (*S. americanum*, *S. villosum*, *S. nigrum* and *S. xanthocarpum*) also shows variations in chromosome number which ranges from $2n=24$ to $2n=72$. According to Jones (1979)^[31] these chromosomal variations are useful in taxonomic studies of plants. Therefore, this database about chromosome number of medicinal angiosperms is compiled from literature.

Table 1: List of plant species with chromosome number

S. No.	Family	Botanical Name	Chromosome number (2n)	References
1.	Asteraceae	<i>Ageratum conyzoides</i> (L.) L.	20	Mehra and Sidhu (1960) ^[41] , Kaul (1967) ^[33] , Sidhu and Pelia (1987) ^[54] , Gupta and Gill (1989) ^[24] , Gaonkar and Torne (1991) ^[18] and Bala and Gupta (2013) ^[4]
			30 and 40	Gill and Garg (2016) ^[21]
2.	Asteraceae	<i>Calendula officinalis</i> L.	28	Fedrov (1974) ^[16] and Sidhu <i>et al.</i> (2009) ^[53]
			32	Gupta and Gill (1989) ^[24]
			14	Carr <i>et al.</i> (1999) ^[10]
3.		<i>Cichorium intybus</i> L.	18	Stebbins <i>et al.</i> (1953) ^[59] and Gupta and Gill (1983) ^[26]
4.		<i>Eclipta prostrata</i> (L.) L.	22	Solbrig <i>et al.</i> (1972) ^[56] , Sidhu <i>et al.</i> (2009) ^[53] and Bala and

				Gupta (2013) ^[4] and Sharma and Sidhu (2017) ^[50]
5.		<i>Erigeron bonariensis</i> Linn. (Syn. <i>Conyza bonariensis</i> (L.) Cronquist)	26	Gupta and Gill (1983) ^[26] and Singh and Sidhu (2022) ^[55]
6.		<i>Launaea asplenifolia</i> (Willd.) Hook. f.	12	Sarkar <i>et al.</i> (1973) ^[49] , Sarkar <i>et al.</i> (1974) ^[48] and Gupta and Gill (1981) ^[25]
7.		<i>Launaea nudicaulis</i> (L.) Hook. f.	18	Chikkannaiah and Hiremath (1982) ^[11] , Kamel (2004) ^[32] , Sidhu <i>et al.</i> (2009) ^[53] and El-Twab and Mohamad (2014) ^[15]
8.		<i>Saussurea candicans</i> Clarke	34	Gupta and Gill (1989) ^[24] and Sidhu <i>et al.</i> (2009) ^[53]
9.		<i>Silybum marianum</i> (L.) Gertn.	34	Powell <i>et al.</i> (1974) ^[43] and Asghari-Zakaria <i>et al.</i> (2008) ^[2]
10.		<i>Sonchus asper</i> (L.) Hill	18	Razaq <i>et al.</i> (1994) ^[46] , Gupta and Gill (1983) ^[26] ; Sidhu and Singh (2021) ^[52]
11.		<i>Sonchus oleraceus</i> (L.) L.	32	Razaq <i>et al.</i> (1994) ^[46] ; Gupta and Gill (1983) ^[26] and Sidhu and Singh (2021) ^[52]
			16	Marchal (1920) ^[40]
12.		<i>Sonchus wightianus</i> DC.	18	Razaq <i>et al.</i> (1994) ^[46]
13.		<i>Tridax procumbens</i> L.	36	Turner and King (1964) ^[63] ; Zhen-Yu and Cheng-Mu (2003) ^[67]
14.		<i>Vernonia cinerea</i> (L.) Less.	18	Sidhu <i>et al.</i> , (2009) ^[53]
15.		<i>Youngia japonica</i> (L.) DC	16	Carr <i>et al.</i> (1999) ^[10] ; Sidhu <i>et al.</i> , (2009) ^[53]
16.	Cannabaceae	<i>Cannabis sativa</i> L.	20	Srivastava <i>et al.</i> (1999) ^[57] ; Sidhu <i>et al.</i> , 2011 ^[51]
			32	Vij and Singh (1976) ^[64]
17.	Convolvulaceae	<i>Convolvulus arvensis</i> L.	48	Gill (1972) ^[22] , Koul and Gohil (1973) ^[35] , Stace (1973) ^[58] , Love (1974) ^[39] , Vij and Singh (1976) ^[64] and Garcia-Baudin and Darmency (1979) ^[19]
			50	Wolcott (1937) ^[65]
18.		<i>Merremia hederacea</i> (Burm.f.) Hallier f.	30	Baquar (1967) ^[6] , Sampath Kumar (1979) ^[47] and Yeh and Tsai (1995) ^[66]
19.	Euphorbiaceae	<i>Euphorbia geniculata</i> Orteg.	14	Choda and Mehra (1972) ^[12] and Sidhu <i>et al.</i> (2011) ^[51]
20.		<i>Ricinus communis</i> L.	20	Jakob (1956) ^[30] , Datta (1967) ^[14] , Gill <i>et al.</i> (1973) ^[20] and Bala <i>et al.</i> (2011) ^[5]
21.	Fabaceae	<i>Sesbania bispinosa</i> (Jacq.) W. Wight	12	Parihar and Zadoo (1987) ^[42] , Jahan <i>et al.</i> (1994) ^[29] ; Singh and Sidhu (2022) ^[55]
22.	Fumariaceae	<i>Fumaria indica</i> (Hausskin.) Pugsley	48	Loon (1974) ^[38]
23.	Lamiaceae	<i>Salvia plebeia</i> R. Br.	16	Thoppil (1993) ^[61] and Tunamoto <i>et al.</i> (2000) ^[62]
24.	Malvaceae	<i>Sida cordata</i> (Burm. f.) Borss. Waalk	16	Kumar <i>et al.</i> (2012) ^[36]
25.		<i>Sida cordifolia</i> Linn.	16	Kumar <i>et al.</i> (2012) ^[36] and Singh and Sidhu (2022) ^[55]
26.		<i>Datura innoxia</i> Mill.	24	El-Twab <i>et al.</i> (2010) and Singh and Sidhu (2022) ^[55]
27.		<i>Nicotiana plumbaginifolia</i> Viv.	20	Kaur <i>et al.</i> (2015) ^[34] and Singh and Sidhu (2022) ^[55]
28.		<i>Petunia hybrida</i> Vilm.	14	Steere (1932) ^[60] , Lewis-Smith <i>et al.</i> (1990) ^[37] and Sidhu <i>et al.</i> (2011) ^[51]
29.		<i>Physalis angulata</i> Linn.	48	Azeez <i>et al.</i> (2019) ^[3]
30.		<i>Solanum americanum</i> Mill	24	Ganapathi and Rao (1986) ^[17] and Singh and Sidhu (2022) ^[55]
31.		<i>Solanum nigrum</i> L.	48	Ganapathi and Rao (1986) ^[17] and Singh and Sidhu (2022) ^[55]
32.	Solanaceae	<i>Solanum villosum</i> Mill	72	Ganapathi and Rao (1986) ^[17] and Singh and Sidhu (2022) ^[55]
33.		<i>Solanum virginianum</i> L. (Syn. <i>Solanum xanthocarpum</i> Schrad. & Wendl.)	24	Jagatheeswari (2013) ^[28] and Singh and Sidhu (2022) ^[55]
34.		<i>Withania somnifera</i> (L.) Dunal	48	Bhaduri (1933) ^[7] , Gottschalk (1954) ^[23] , Baquar (1967) ^[6] , Bir and Sidhu (1980) ^[9] , Al-Turki <i>et al.</i> (2000) ^[1] , Iqbal and Datta (2007) ^[27] , Sidhu <i>et al.</i> (2011) ^[51] and Ram <i>et al.</i> (2012) ^[44]
			72	Bir and Neelam (1980) ^[8]

Conclusion

Chromosomes of thirty four angiosperm species have shown great variation in number and ploidy. Some species have same chromosome number under same genus and also under different genus as well as family. This database will be helpful for comparative study of chromosome number and evolutionary behaviour of plants.

Acknowledgements

Authors are grateful to Smt. Bhupinder Kaur Sran (Principal) and Sr. Swarnjit Singh Gill (Chairman) Sangat Sahib Bhai Pheru Khalsa Senior Secondary School, Faridkot, Punjab, India for providing necessary facilities for this research work.

References

1. Al-Turki TA, Filfilan SA, Mehmood SF. A cytological study of flowering plants from Saudi Arabia. *Willdenowia*, 2000;30:339-358.
2. Asghari-Zakaria R, Panahi AR, Sadeghizadeh M. Comparative Study of Chromosome Morphology in *Silybum marianum*. *Cytologia*, 2008;73(3):327-332.
3. Azeez SO, Faluyi JO, Oziegbe M. Cytological, foliar epidermal and pollen studies in relation to ploidy levels in four species of *Physalis* L. (*Solanaceae*) From Nigeria. *International Journal of Biological and Chemical Sciences*, 2019;13(4):1960-1968.
4. Bala S, Gupta RC. Male Meiosis and Chromosome Number in Asteraceae Family from District Kangra of

- H. P. (Western Himalaya). International Journal of Botany and Research,2013:3(1):43-58.
5. Bala S, Gupta RC, Attri PB. Cytomorphological studies on Monochlamydeae from North India. Chromosome Botany,2011:6:45-51.
 6. Baquar SR. Chromosome number in Some Vascular plants of East Pakistan, Rev. Biol,1967:6:440-448.
 7. Bhaduri PN. Chromosome numbers of some solanaceous plants of Bengal. Journal of Indian Botanical Society,1933:14:56-64.
 8. Bir SS, Sidhu M. Cyto-palynological studies on weed flora of cultivable lands of 79-81 Patiala District. Journ. Palynol,1980:16:85-105.
 9. Bir SS, Neelam. In: Chromosome number reports LXIX. *Taxon*,1980:29:703-730.
 10. Carr CD, King RM, Powell AM, Robinson H. Chromosome numbers in compositae. XVIII. American Journal of Botany,1999:86(7):1003-1013.
 11. Chikkannaiah PS, Hiremath BS. Embryological studies In *Launaea nudicaulis* Hook. Proceedings of Indian Academy of Science (Plant Science). Indian Acad. Sci., Pl. Sci.,1982:91:519-527.
 12. Choda SP, Mehra PN. Cytological studies in some Euphorbiaceae. Current Science,1972:41:76.
 13. Christenhusz MJM, Byng JW. The number of known plants species in the world and its annual increase. *Phytotaxa*,2016:261(3):201-217.
 14. Datta N. In IOPB chromosome number reports XII. *Taxon*,1967:16:341-350.
 15. El-Twab MHA, Mohamed MH. Karyomorphological study on some species of *Launaea* in Egypt. *Chromosome Botany*,2014:9:73-76.
 16. Fedrov A. Chromosome numbers of flowering plants. Otto Koeltz, Koenigstein, 1974.
 17. Ganapathi A, Rao GR. Taxonomic status of the *Solanum nigrum* complex found in India. Proceedings of the National Science Academy,1986:96(3):241-246.
 18. Gaonkar RV, Torne SG. Induced autotetraploidy in *Ageratum conyzoides* L. *Cytologia*,1991:56:327-331.
 19. Garcia-Baudin JM, Darmency H. Differences intraspecifics chez *Convolvulus arvensis* L. *Weed Research*,1979:19: 219-224.
 20. Gill BS, Chawla A, Kanwal R. Cytological Studies in North-West Indian Euphorbiaceae. *Cytologia*,1973:38:393-401.
 21. Gill A, Garg P. Cytomorphological diversity of *Ageratum* Species from North-West India. *Annals of Plant Sciences*,2016:5(3):1289-1295.
 22. Gill LS. Chromosome numbers in west- Himalayam Bicarpellate species II. Bull. Torr. Bot. Club,1972:99:36.
 23. Gottschalk W. Die Chromosomen struktur der Solanaceen unter Berucksichtigung phylogenetischer Fragestellungen. *Chromosoma*,1954:6:539-626.
 24. Gupta RC, Gill BS. Cytopalynology of North and Central Indian Compositae. *Journal of Cytology and Genetics*,1989:24:96-105.
 25. Gupta RC, Gill BS. In Chromosome number reports LXXI. *Taxon*,1981:30:514.
 26. Gupta RC, Gill BS. Cytology of Family Compositae of the Punjab Plains. Proceedings of the National Science Academy,1983:49(4):359-370.
 27. Iqbal M, Datta AK. Cytogenetic Studies in *Withania somnifera* (L.) Dun. (Solanaceae). *Cytologia*,2007:72(1):43-47.
 28. Jagatheeswari D. Cytotaxonomical studies on some members of Solanaceae. International Journal of Pharmaceutical and Biological Archives,2013:4(1):175-178.
 29. Jahan B, Vahidy AA, Ali SS. Chromosome numbers in some taxa of Fabaceae mostly native to Pakistan. *Annals of Missouri Botanical Garden*,1994:81:792-799.
 30. Jakob KM. The pachytene chromosomes of the castor oil plant. *Cytologia*,1956:21:76-80.
 31. Jones K. Aspects of chromosome evolution in higher plants. *Advances in Botanical Research*,1979:6:119-193.
 32. Kamel. Cytotaxonomical investigations of the Egyptian Compositae (Asteraceae): I Cardueae and Cichorieae. *Compositae Newsletter*,2004:41:9-28.
 33. Kaul MLH. Cytogenetics of polyploids. III. Dauermodifications in *Ageratum conyzoides* L. *Cytologia*,1967:32:147-156.
 34. Kaur K, Ramanpreet Gupta RC, Kumari S. Cytomorphological studies of some dicot plants from Rajasthan (India). *Cytologia*,2015:80(3):353-362.
 35. Koul AK, Gohil RN. Cytotaxonomical conspectus of the flora of Kashmir. (1) Chromosome numbers of some common plants. *Phyton*,1973:15:57-66.
 36. Kumar S, Kumari S, Gupta RC. Cytological investigations of some polypetalous plants from District Sirmaur of Himachal Pradesh in the Western Himalayas, India. *Chromosome Botany*,2012:7:87-96.
 37. Lewis-Smith AC, Chamberlain M, Smith SM. Genetic and chromosomal variation in *Petunia hybrida* plants regenerated from protoplast and callus cultures. *Biologia Plantarum*,1990:32(4):247-255.
 38. Loon JCV. A cytological investigation of flowering plants from the Canary Island. *Acta Botanica Neerlandica*,1974:23(2):113-124.
 39. Love A. IOTB chromosome number reports XLV. *Taxon*,1974:23:619-624.
 40. Marchal E. Recherches sur les variations numeriques des chromosomes devs la serie vegetale. *Academic royle de Belgique classe science Memories*,1920:4:5-108.
 41. Mehra PN, Sidhu SS. Cytology of the North-West Indian Compositae. Proceedings of 47th Indian Science Congress,1960:3:376-377.
 42. Parihar RS, Zadoo SN. Cytogenetical studies on genus *Sesbania* Scop. *Cytologia*,1987:52:507-512.
 43. Powell AM, Kyhos DW, Raven PH. Chromosome numbers in compositae. X. American Journal of Botany,1974:6:909-9132.
 44. Ram H, Kumar A, Sharma SK, Ojha A, Rao SR. Meiotic studies in *Withania somnifera* (L.) Dunal: A threatened medicinal herb of Indian Thar Desert. *American Journal of Plant Science*,2012:3:185-189.
 45. Raven PH. The bases of angiosperm phylogeny: Cytology. *Annals of Missouri Botanical Garden*,1975:62(3):724-764.
 46. Razaq ZA, Vahidy Aa, Ali SI. Chromosome numbers in compositae from Pakistan. *Annals of Missouri Botanical Garden*,1994:81(4):800-808.

47. Sampath Kumar R. Karyomorphological studies on some South Indian Convolvulaceae, *Cytologia*,1979:44:275-286.
48. Sarkar AK, Datta N, Chatterjee U. In IOPB chromosome number reports XLVI. *Taxon*,1974:23:801-812.
49. Sarkar AK, Datta N, Chatterjee U. Reports, 652-653. In Love, A. (ed.) IOPB chromosome number reports XLII. *Taxon*,1973:22:647-654.
50. Sharma T, Sidhu MC. Cytomorphological and preliminary phytochemical screening of *Eclipta alba* (L.) Hassk. *International Journal of Green Pharmacy*,2017:11(1):23-32.
51. Sidhu MC, Kumari S, Azad N, Kaur S, Namita. Meiotic valuation in some angiosperms, *Vegetos*,2011:24(2):49-54.
52. Sidhu MC, Singh R. A cytomorphological investigation of three species of the genus *Sonchus* L. (Asterales: Asteraceae) from Punjab, India. *Journal of Threatened Taxa*,2021:13(11):19640-19644.
53. Sidhu MC, Namita Kumari S, Azad N. Chromosomal manifestation in ten selected members of family Asteraceae from Chandigarh (India). *Vegetos*,2009:22(2):51-57.
54. Sidhu M, Pelia SS. Karyomorphology of some species of weeds-Compositae. *Journal of Cytology and Genetics*,1987:22:143-150.
55. Singh R, Sidhu MC. Cytotaxonomy and Palynology study of some weed species from the state of Punjab, India. *Journal of Threatened Taxa*,2022:1(4):20866-20872.
56. Solbrig OT, KyhosDW, Powell M, Raven PH. Chromosome numbers in compositae VIII: Heliantheae. *American Journal of Botany*,1972:59(8):869-878.
57. Srivastava P, Srivastava S, Verma MK, Mishra SK. Karyological Studies in Root-Tip Cells of *Cannabis sativa* var. *indica*. *Cytologia*,1999:64:435-440.
58. Stace CA. Chromosome numbers in the British species of *Calystegia* and *Convolvulus*. *Watsonia*,1973:9:363-367.
59. Stebbins GL, Jenkins JA, Walters MS. Chromosomes and phylogeny in the Compositae, tribe Cichorieae. *University of California Publications Bulletin*, 1953:26:401-430.
60. Steere WC. Chromosome behaviour in triploid *Petunia* hybrids. *American Journal of Botany*,1932:19(4):340-357.
61. Thoppil JE. Chromosome studies and exploration of chemical constituents in some members of South Indian Lamiaceae. Ph.D. Thesis, The Mahatma Gandhi University, Kottayam, 1993, 309.
62. Tunamoto T, Zushi M, Horana T, Nakamura T. Comparative karyomorphology of the Japanese species of *Slavia* L. (Lamiaceae). *J. Phytogeograph. Taxon*,2000:48:11-18.
63. Turner BL, King RM. Chromosome numbers in the compositae. VIII. Mexican and Central American species. *The Southwest Naturalist*,1964:9(1):27-39.
64. Vij SP, Singh S. Cytomorphological studies in Convolvulaceae. I. *Convolvulus* L. *Cytologia*,1976:41:299-305.
65. Wolcott GB. Chromosome numbers in the Convolvulaceae. *The American Naturalist*,1937:71:190-192.
66. Yeh HC, Tsai JJ. Karyotype analysis of the Convolvulaceae in Taiwan. *Annual Taiwan Mus*,1995:38:58-61.
67. Zhen-Yu X, Cheng-Mu Z. Cytological studies on 13 species of compositae from Hainan, China. *Acta Phytotaxonomica Sinica*,2003:41(6):545-552.