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菊科栽培植物黄鹌花的核型分析

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摘要:研究了我国广东佛山栽培的菊科(Asteraceae)植物黄鹌花(*Solidago canadensis* var. *gilvocanescens* Rydb.)的染色体数目和核型。其染色体数目为 $2n=18$,带有一对随体,核型公式为 $2n=2x=18=14m+4sm$ (2SAT),核型类型为"2A"型。

关键词:黄鹌花; 菊科; 染色体数目; 核型
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Karyotype of *Solidago canadensis* var. *gilvocanescens* Rydb., A Cultivar in the Asteraceae

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Abstract: The chromosome number and karyotype of a cultivar in the Asteraceae, *Solidago canadensis* var. *gilvocanescens* Rydb., cultivated in Foshan City, Guangdong Province, China, were reported. The chromosomes were counted to be $2n=18$, and one pair of them had satellites on their short arms. The karyotype was formulated as $2n=2x=18=14m+4sm$ (2SAT), and belonged to Stebbins' 2A type.

Key words: *Solidago canadensis* var. *gilvocanescens* Rydb.; Asteraceae; Chromosome number; Karyotype

加拿大一枝黄花(*Solidago canadensis* L.)是菊科(Asteraceae)一枝黄花属植物,原产于北美洲,曾被作为观赏植物引种到世界各地,后逸生为恶性杂草,对当地的经济、自然环境造成了一定危害[1]。20 世纪 30 年代,该植物作为庭院花卉引种到我国上海、南京等地[2],后来逸生为杂草,目前已经广泛分布于我国东南、东北、中部、西南地区以及台湾等地,且扩张相当迅速[1],多见于路边、住宅周围、疏林果园和荒地等生境,已成为我国部分地区常见的一种杂草[3]。

黄鹌花(*Solidago canadensis* var. *gilvocanescens* Rydb.) (图版 I: A)是加拿大一枝黄花的栽培品种,近年来大量应用于鲜切花的配花,引种栽培广泛[4],我国广东、云南等地有栽培。黄鹌花与加拿大一枝黄花的形态特征十分相似,如叶缘具锐齿,头状花序在花序轴上排成蝎尾状再组合成开展的大型圆锥花序等。但黄鹌花是否具有像加拿大一枝黄花一样的入侵性值得深入研究。

目前,报道原产地和入侵地的加拿大一枝黄花染色体数目变化较大,染色体数目有 $2n=18$、36、50、54 等[5-33]。国内主要从分子水平[4,34]对黄鹌花进行研究,尚未见其染色体数目和核型的报道。本文对广东佛山栽培的黄鹌花进行染色体数目和核型分析,讨论其染色体数目变化较大的可能原因,为研究其入侵机制提供细胞学资料。

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1 材料和方法

黄鹌花(*Solidago canadensis* var. *gilvocanescens* Rydb.)采自广东佛山南海和胜花场地畦,栽培于中国科学院华南植物园温室。凭证标本保存于中国科学院华南植物园标本馆(IBSC)。

取幼嫩根尖用 0.1% 秋水仙素于室温下预处理 3 h,4℃下用卡诺氏固定液固定,用 1 mol/L HCl 于 60±1℃恒温解离 5~6 min,改良苯酚品红染色,压片。核型分析采用李懋学和陈瑞阳[35]的标准,共分析 5 个细胞。核型类型按照 Stebbins 的标准[36]。

2 结果

黄鹌花的染色体数目为 18(图 1A),核型公式为 $2n=2x=18=14m+4sm$ (2SAT)(图 1B)。核型模式见图 1C。染色体为中部着丝粒染色体(m 型)或近中部着丝粒染色体(sm 型)。核型不对称系数为 61.11,相对长度为 9.91~14.54。臂比大于 2 的染色体比例为 0.11,最长染色体与最短染色体的比值为 1.47,核型属“2A”型(表 1)。

据不完全统计,国内外报道的加拿大一枝黄花的染色体数目多种多样[5-33](表 2)。

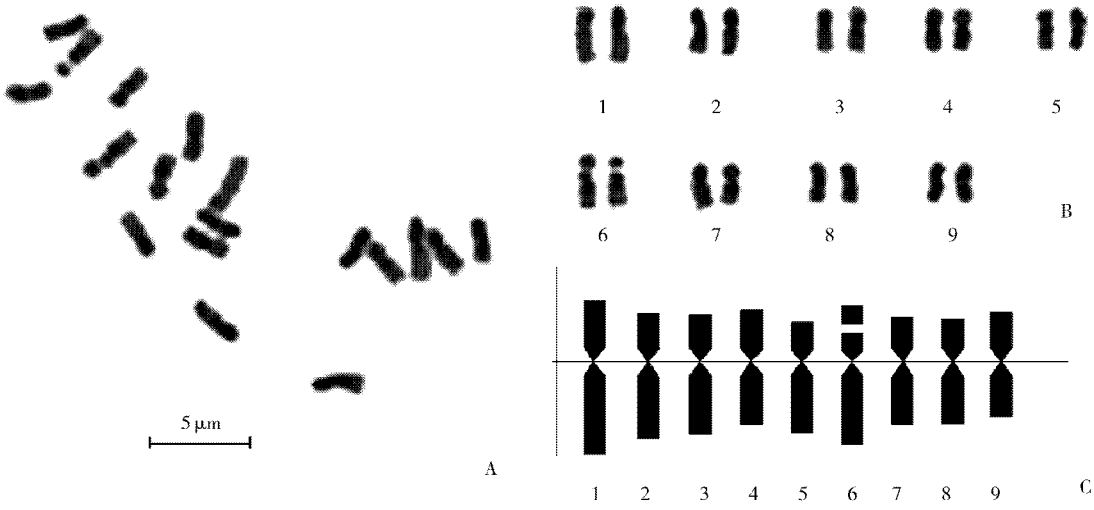

图 1 黄鹌花的中期染色体

Fig. 1 Metaphase chromosomes of *Solidago canadensis* var. *gilvocanescens*

A. 中期形态 Metaphase chromosomes; B. 核型 Karyogram; C. 核型模式 Idiogram

表 1 黄鹌花的核型参数

Table 1 Karyotype parameters in *Solidago canadensis* var. *gilvocanescens*

序号 No.	相对长度 Relative length (%)			相对长度系数 Index of relative length	着丝粒指数 Centromere index	臂比 Arm ratio (L/S)	类型 Type
	短臂 Short arm	长臂 Long arm	总长 Total				
1	5.76	8.78	14.54	1.31	39.64	1.52	m
2	4.56	7.31	11.87	1.07	38.44	1.6	m
3	4.39	6.9	11.29	1.02	38.87	1.57	m
4	4.84	6.06	10.9	0.98	44.4	1.25	m
5	3.77	6.81	10.59	0.95	41.32	1.42	m
6	2.59	7.96	10.55	0.95	24.52	3.08	sm*
7	4.26	6.05	10.31	0.93	35.65	1.81	sm
8	4.04	5.99	10.03	0.9	40.26	1.48	m
9	4.67	5.24	9.91	0.89	47.11	1.12	m

* 随体长度未计算在内。The length of satellite has not been taken into computation.

表 2　加拿大一枝黄花类群的染色体数目

Table 2　List of chromosome numbers of *Solidago canadensis* L. complex

类群 Taxon	染色体数目 Chromosome numbers		采集地 Localities	文献 Reference
	n	2*n*		
Solidago	9	18	Quebec, Canada	[5-7]
canadensis L.	9		Darjeeling, India	[8]
		18	Poland	[9]
		18	Nova Scotia, Canada	[10]
	27		West Bengal, India	[11]
	20～24	7～60	Calcutta, India	[12]
	9		North Carolina, USA	[13]
		18	California & Oregon, USA	[14]
		54	Idaho, Washington & Wyoming, USA	[14]
		18	Alaska, USA	[15]
		18	New Mexico & Colorado, USA	[16]
		18	California, Oregon, Montana & Utah, USA	[17]
		54	Anhui, Zhejiang, China	[18]
		50 +6B	Anhui, China	[19]
		54	Nanjing, China	[20]
Solidago	9 +0 or 1	18, 18 +2 or 3,	Quebec, Canada	[21]
canadensis var.		18 +0 to 2, 18 +1		
canadensis		18	Massachusetts, USA	[21]
		9Ⅱ		[22]
		18	Quebec, Canada; Massachusetts,	[23]
			New York & Vermont, USA	
		9Ⅱ	Ontario, Canada	[23]
		18		[17,24]
		18	Illinois, USA	[16,25]
		18	New Brunswick, Nova Scotia & Ontario,	[14]
			Canada; Maine, Massachusetts,	
			Hampshire, & Vermont, USA	
	9 +4B,		Kansas, USA	[26]
	9		Wyoming, USA	
		18	southern Poland	[27]
		18	Manitoba, Canada	[28]
Solidago		36	Tennessee, USA	[29]
canadensis aff.				
var. *canadensis*				
Solidago		18	Quebec, Canada	[21]
canadensis var.	9		Manitoba, Canada; North Dakota,	[30]
hargeri Fernald			Nebraska & Kansas, USA	
		18	Ontario, Canada	[14,24,31]
Solidago	27		Harney & Oregon, USA	[32]
canadensis var.		18	Oregon, USA	[25]
salebrosa (Piper)	9		Mexico	[26]
M. E. Jones		18	Wyoming, Colorado & Montana, USA	[29]
Solidago	27		North Dakota, Nebraska & Kansas, USA	[30]
canadensis var.	27		New Mexico, USA	[26]
scabra (Muhl. ex Willd.)	27		New Mexico & Texas, USA	[33]
Torr. & A. Gray		18 +1-2B	southern Poland	[27]
Solidago canadensis		18	Manitoba, Canada	[28]
var. *gilvocanescens*	9		South Dakota, USA	[30]
Rydb.		18	Foshan, China	This paper

3 讨论

一枝黄花属的染色体基数为 $x=9$[21,37]。本研究表明黄莺花的染色体数目为 $2n=18$,为二倍体,国内首次报道。加拿大一枝黄花原产地在北美,现在广泛分布于世界各地,成为入侵植物。目前关于加拿大一枝黄花的入侵机制的研究主要有生理生态和细胞学等方面。董梅[1]等认为,外来种成功入侵的机制主要是外来物种的入侵力和被入侵地的可入侵性,该文提出加拿大一枝黄花的入侵力有高繁殖力、竞争与化感作用及菌根营养的利用。张中信[18]等从细胞学上研究认为,加拿大一枝黄花的入侵性与其多倍性有关,即多倍体具有较强的入侵性。本文及现有资料(表 2)中表明,原产地的和入侵地的该植物染色体数目均变化较大,倍性有二倍体、四倍体、六倍体,有的还含有 B 染色体。各亚种和变种虽然在染色体数目上不同,但形态上十分相似,且仅从某些数量性状就能将它们区分[24],可见加拿大一枝黄花可能本身具有遗传多样性,是一个由具不同染色体数目的亚种和变种组成的多倍体复合体[1]。加拿大一枝黄花的这种特性为其成功入侵不同生境奠定了遗传基础,在世界各地均分布有不同遗传特性(多种倍性及含 B 染色体)的加拿大一枝黄花,因而,就本研究来看,该植物的多倍性与其入侵的细胞学机制并无一定相关性,多倍体的重要性在其入侵的细胞学机制中的作用仍需探讨。有关其入侵机制还需结合其他因素进一步研究。

参考文献

[1] Dong M(董梅), Lu J Z(陆建忠), Zhang W J(张文驹), et al. Canada goldenrod (*Solidago canadensis*): An invasive alien weed rapidly spreading in China [J]. Acta Phytotax Sin(植物分类学报), 2006, 44(1): 72-85.(in Chinese)

[2] Li Z Y(李振宇), Xie Y(解焱). Chinese Invasive Species [M]. Beijing: Chinese Forest Industry Press House, 2002: 170.(in Chinese)

[3] Science & Technology Academy of Shanghai(上海科学院). The Plants of Shanghai Vol. 1 [M]. Shanghai: Shanghai Science & Technological Literature Publishing House, 1999: 606-607.(in Chinese)

[4] Ma L(马玲), Qiang S(强胜). Identification and classification of cut-flower "Huangyinghua" using DNA marker techniques [J]. Acta Phytotax Sin(植物分类学报), 2007, 45(4): 497-504.(in Chinese)

[5] Beaudry J R, Chabot D L. Studies on *Solidago* L. I. *S. altissima* L. and *S. canadensis* L. [J]. Contrib Inst Bot Univ Montr al, 1957, 70: 65-72.

[6] Tomkins D J, Grant W F. Morphological and genetic factors influencing the response of weed species to herbicides [J]. Can J Bot, 1978, 56:1466-1471.

[7] Löve Á, Löve D. IOPB chromosome number reports LXXVII [J]. Taxon, 1982, 31: 766-768.

[8] Mehra P N, Gill B S, Mehta J K, et al. Cytological investigations on the India *Cympositae*. I. North India taxa [J]. Caryologia, 1965, 18: 35-68.

[9] Skalinska M E, Pogan R, Czapik, et al. Further studies in chromosome numbers of Polish angiosperms. XII [J]. Acta Biol Cracov Bot, 1978, 21: 31-63.

[10] Kapoor B M. Supernumerary chromosomes of some species of *Solidago* and a related taxon [J]. Caryologia,1978, 31: 315-330.

[11] Sarkar A K, Chakraverty M, Das S K, et al. Chromosome number reports LXVII [J]. Taxon, 1980, 29: 358-360.

[12] Dey D. A cytotype of *Solidago canadensis* L. [J]. Sci Cult, 1981, 47: 323-325.

[13] Keil D J. IOPB chromosome number reports LXIII [J]. Taxon, 1979, 28: 271-273.

[14] Semple J C, Ringius G S, Leeder C, et al. Chromosome numbers of goldenrods, *Euthamia* and *Solidago* (Compositae: Astereae). II. Additional counts with comments on cytogeography [J]. Brittonia, 1984, 36: 280-292. [Erratum 37: 121]

[15] Chinnappa, C C, Chmielewski J G. Documented plant chromosome numbers 1987: 1. Miscellaneous counts from western North America [J]. Sida, 1987, 12: 409-417.

[16] Semple J C, Chmielewski J G. Chromosome number determinations in fam. Compositae, tribe Astereae. II. Additional counts [J]. Rhodora, 1987, 89: 319-325.

[17] Semple J C, Chmielewski J G, Lane M E. Chromosome number determinations in fam. Compositae, tribe Astereae. III. Additional counts and comments on generic limits and ancestral base numbers [J]. Rhodora, 1989, 91: 296-314.

[18] Zhang Z X(张中信), Zhang X P(张小平), Shao J W(邵剑文), et al. Cytological mechanism of *Solidago canadensis* invasion [J]. Acta Laser Biol Sin(激光生物学报), 2007, 16(5): 603-607.(in Chinese)

[19] Cai H(蔡华), Wang R F(王荣富). Karyotype analysis of *Solidago canadensis* L. and preliminary study on its B-chromosomes [J]. Acta Laser Biol Sin(激光生物学报), 2006, 15: 245-248.(in Chinese)

[20] Li Y Z(李亚仲), Yin L P(印丽萍), Wang Q Y(王庆亚), et al. Karyotype of *Solidago canadensis* from Wild Population in Nanjing [J]. Jiangsu J Agri Sci(江苏农业学报), 2007, 23(1): 74-75.(in Chinese)

[21] Beaudry J R, Chabot D L. Studies on *Solidago* L. Ⅳ. The chromosome numbers of certain taxa of the genus *Solidago* [J]. Can J Bot, 1959, 37: 209-228.

[22] Semple J C, Zhang J, Xiang C. Chromosome number determinations in fam. Compositae, tribe Astereae. V. Eastern North American taxa [J]. Rhodora, 1993, 95: 234-253.

[23] Semple J C, Brammall R A, Chmielewski J. Chromosome numbers of goldenrods, *Euthamia* and *Solidago* (Compositae-Astereae) [J]. Can J Bot, 1981, 59: 1167-1173.

[24] Melville M R, Mortorn J K. A biosystematic study of the *Solidago Canadensis* (Compositae) complex. Ⅰ. The ontario population [J]. Can J Bot, 1982, 60: 976-997.

[25] Semple J C. Chromosome number determinations in fam. Compositae tribe Astereae [J]. Rhodora, 1985, 87: 517-527.

[26] Ward D E, Spellenberg R W. Chromosome counts of angiosperms of western North America [J]. Phytologia, 1986, 61: 119-125.

[27] M lecka J. Studies on the genus *Solidago* L. I. Karyotype analysis of *Solidago canadensis* L. s.l [J]. Acta Biol Cracov Bot, 1989, 30: 137-145.

[28] Löve Á. IOPB chromosome number reports LXXV [J]. Taxon, 1982, 31(2): 344-360.

[29] Semple J C, Chmielewski J G, Xiang C. Chromosome number determinations in fam. Compositae, tribe Astereae. IV. Additional reports and comments on the cytogeography and status of some species of *Aster* and *Solidago* [J]. Rhodora, 1992, 94: 48-62.

[30] Croat T. *Solidago canadensis* complex of the Great Plains [J]. Brittonia, 1972, 24: 317-326.

[31] Pringle J S. Documented plant chromosome numbers 1979: 1 [J]. Sida, 1979, 8: 119-120.

[32] Raven P H, Solbrig O T, Kyhos D W, et al. Chromosome numbers in Cympositae I. Astereae [J]. Amer J Bot, 1960, 47(2): 124-132.

[33] Ward D E, Spellenberg R. Chromosome counts of angiosperms from New Mexico and adjacent areas [J]. Phytologia, 1988, 64: 390-398.

[34] Yin L P(印丽萍), Chen Y(陈言), Wang W(王伟), et al. Phylogenetic relationship of *Solidago canadensis* L. and Huangying based on ITS [J]. Plant Quarantine(植物检疫), 2006, S1: 19-21. (in Chinese)

[35] Li M X(李懋学), Chen R Y(陈瑞阳). The standardization about the karyotype analysis [J]. J Wuhan Bot Res(武汉植物学研究), 1985, 3: 297-302.(in Chinese)

[36] Stebbins G L. Chromosomal Evolution in Higher Plants [M]. London: Edward Arnold, 1971: 87-89.

[37] Goodwin R H. The cyto-genetics of two species of *Solidago* and its bearing on their polymorphy in nature [J]. Amer J Bot, 1937, 24: 425-433.

图版说明

图版Ⅰ

A. 植株; B, C. 头状花序。图 A 中的尺子长度为 30 cm。

Explanation of plate

Plate I

A. Habit; B, C. Capitula. The length of the ruler in Figure A is 30 cm.

叶静等:图版Ⅰ　　YE Jing, et al.: Plate I