“Chromosome evolution and cytotaxonomy of South American species of tribe Vernonieae (Asteraceae)”

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Vernonieae (Asteraceae)

Elephantopus

Eremanthus

Lychnophora

Pacourina

Centratherum

- 124 genera and more than 1500 species
- tropical and subtropical regions of Asia, Africa and America
- mostly centered in southern Brazil
- *Vernonia* was traditionally the largest genus, with about 1.000 species
- In South America grow ca. 380 species
- Mostly distributed in south of Brazil, northern Argentina, Paraguay y Bolivia

Vernonia

Economic Uses

Vernonia galamensis (Cass.) Less.

Epoxy resin extraction

Vernonia anthelmintica (L.) Willd.

weeds

Vernonanthura chamaedrys (Less.) H.Rob.

Lessingianthus rubricaulis (Humb. & Bonpl.) H.Rob.

toxic species

Lessingianthus mollissimus (D.Don) H.Rob.

Biological Forms

Vernonanthura patens (Kunth) H.Rob.

Vernonanthura brasiliana (L.) H.Rob.

Lessingianthus platyphyllus (Chodat) H.Rob.

Lessingianthus brevifolius (Less.) H.Rob.

Heads and Inflorescences

Vernonia incana Less.

Lessingianthus glabratus (Less.) H.Rob.

Eirmocephala megaphylla (Hieron.) H.Rob.

Vernonanthura pseudolinearifolia (Hieron.) Vega & Dematt.

Vernonanthura patens (Kunth) H.Rob.

Lessingianthus brevifolius (Less.) H.Rob.

Lessingianthus longicuspis Dematt.

Cyrtocymura scorpioides (Lam.) H.Rob.

- heads discoid, homogamous
- florets bisexual, fertile, isomorphic
- corollas tubular, 5-lobed, lobes with similar size
- style slender with filiform branches, bearing long sweeping hairs
- florets reddish to purplish, rarely white
- involucre composed by several series of closely imbricate phyllaries

Vernonia Schreb., Gen. Pl. 2: 541. 1791.

Benth. & Hook., Gen. Pl. 2(1): 227-231. 1873.

New World	Old World
Critoniopsis (Sch.Bip.) Benth. & Hook.	*Baccharoides* Moench
Eremosis DC.	*Cyanopis* Blume
Hololepis (DC.) DC.	*Distephanus* Cass.
Leiboldia (Schtdl.) Benth. & Hook.	*Gymnanthemum* Cass.
Lepidaploa (Cass.) DC.	*Lepidella* Oliv. & Hiern.
Stenocephalum (Sch.Bip.) Benth. & Hook.	*Stengelia* Steetz
Tephrodes DC.	*Trianthea* DC.
	Xipholepis Steetz

Vernonia sect. *Lepidaploa* (Cass.) DC.

Bentham & Hooker (1873)	Baker (1873)	Cabrera (1944)	Robinson (1999)
subsect. *Macrocephalae*		subsect. *Brevifolia*	
	subsect. *Macrocephalae*	subsect. *Remotiflorae* p.p.	*Lessingianthus*
subsect. *Macrolepidae*		subsect. *Sellowiinae*	
subsect. *Oligocephalae*	subsect. *Oligocephalae*	subsect. *Flexuosae*	*Chrysolaena*
subsect. *Scorpioideae verae*	subsect. *Scorpioideae*	subsect. *Scorpioides*	*Cyrtocymura*
subsect. *Scorpioideae axilares*	subsect. *Axilliflorae*	subsect. *Remotiflorae* p.p.	*Lepidaploa*
subsect. *Glomeratae*	subsect. *Glomeratae*	subsect. *Chamaedrys*	
			Vernonanthura
subsect. *Paniculatae*	subsect. *Paniculatae*	subsect. *Nudiflorae*	
		subsect. *Nitidulae*	
		subsect. *Polyanthes*	
		subsect. *Laurifoliae*	*Quechualia*

Characters commonly considered

- Inflorescence type
- Size of the inflorescence bracts
- Florets per capitulum
- Phyllaries shape
- Indumentum type

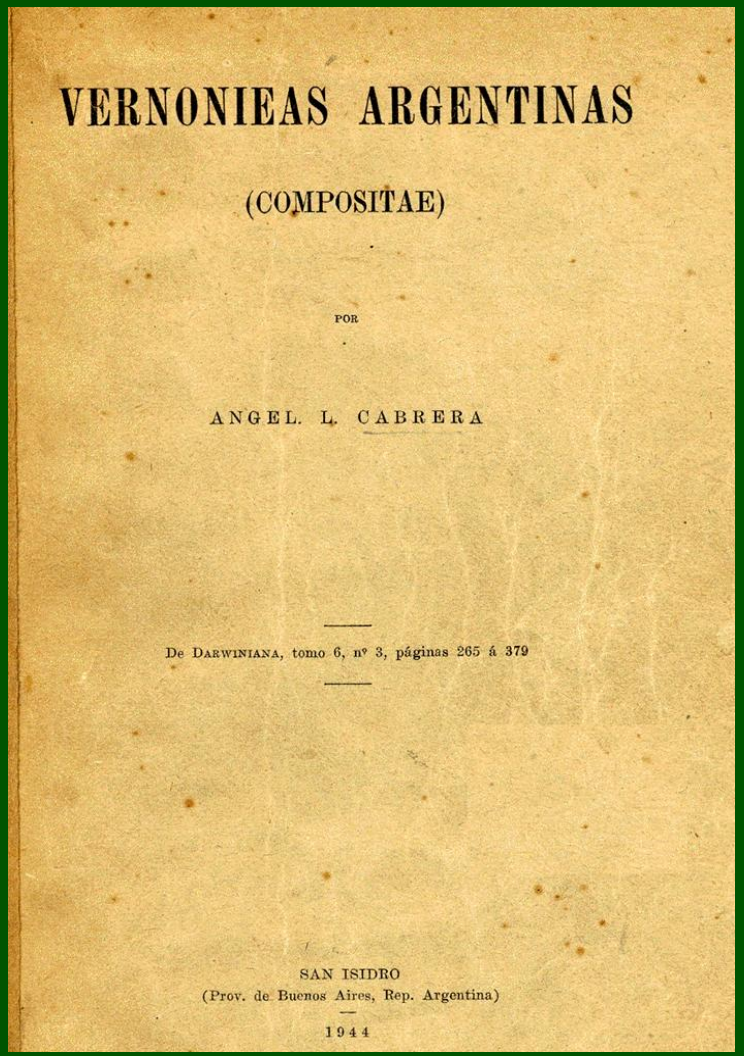
In some cases…

- Pollen morphology
- Floral microcharacters
- Chemical composition
- Number and morphology of chromosomes?

Vernonanthura loretensis (Hieron.) H.Rob.

Chromosome numbers in Vernonieae

First chromosome count



VERNONIEAS ARGENTINAS

(COMPOSITAE)

POR

ANGEL L. CABRERA

De DARWINIANA, tomo 6, nº 3, páginas 265 á 379

SAN ISIDRO
(Prov. de Buenos Aires, Rep. Argentina)

1944

Chrysolaena platensis (Spreng.) H.Rob. (2n=40)

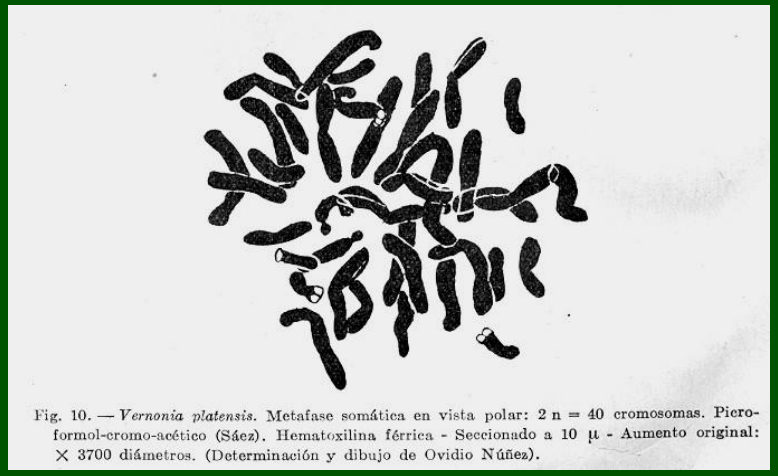


Fig. 10. — *Vernonia platensis*. Metafase somática en vista polar: 2 n = 40 cromosomas. Picro-formol-cromo-acético (Sáez). Hematoxilina férrica - Seccionado a 10 μ - Aumento original: × 3700 diámetros. (Determinación y dibujo de Ovidio Núñez).

First comprehensive analysis in Vernonieae

Table 2. Chromosome numbers reported for species of *Vernonia*.[1]

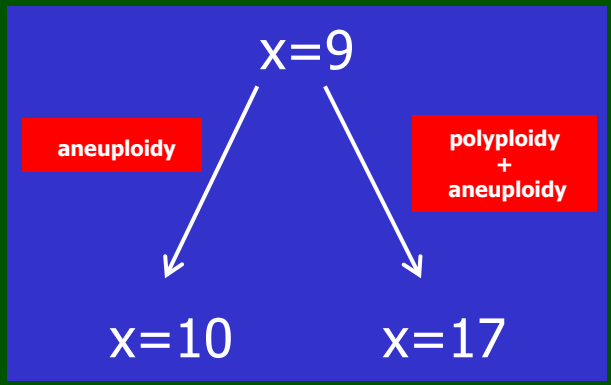
Taxa	8	9	10	14	15	16	17	18	19	20	26	28	30	33	34	36	37	51	68
Old World species[3]		*21*	*22*					2		3			1						
New World species[2,3]	1		1	1	1	2	*58*	3	1	2	1	1		1	4	2	1	2	1

[1] From Bolkhovskikh *et al.* (1969); Moore (1973, 1974, 1977); Mathew and Mathew (1976); Keeley (1977); Sarkar *et al.* (1977); and this paper.
[2] Species with chromosome number of 16 or less, should be recounted since they may be in error.
[3] A total of 45 Old World and 68 New World Vernonias have been counted.

Jones, Bull. Torrey Bot. Club 106: 79-84. 1979.

Asia and Africa x=9 and x=10

America x=17



Current Cytological Information

n =	9	10	14	15	16	17	18	19	20	30	31	32	33	34	36	40	48	64	80
Nro.	38	45	3	5	52	45	2	5	4	2	1	12	2	3	1	3	1	8	1

Basic Chromosome Numbers

x=9, x=10, x=14, x=15, x=16,
x=17, x=19, x=31 and x=33

Dematteis, Bot. J. Linn. Soc. 139: 401-408. 2002
Angulo & Dematteis, Pl. Syst. Evol., in press.

Chrysolaena (*Vernonia* subsect. *Oligocephalae*) (18 spp.)

C. lithospermifolia (Hieron.) H.Rob. n=10 II, 2n=2x=20

C. propinqua (Hieron.) H.Rob. 2n=2x=20

2,5 µm

C. flexuosa (Sims) H.Rob. n=20 II, 2n=4x=40

C. verbascifolia (Less.) H.Rob. 2n=2x=20

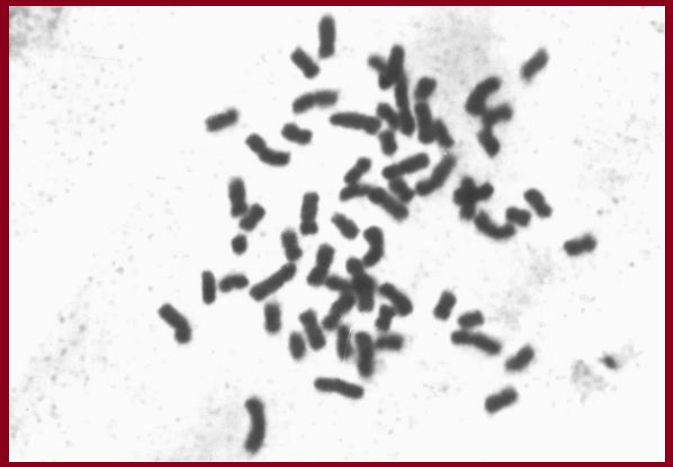
Chrysolaena cognata (Less.) Dematt.

2n=2x=20

2n=4x=40

2n=5x=50

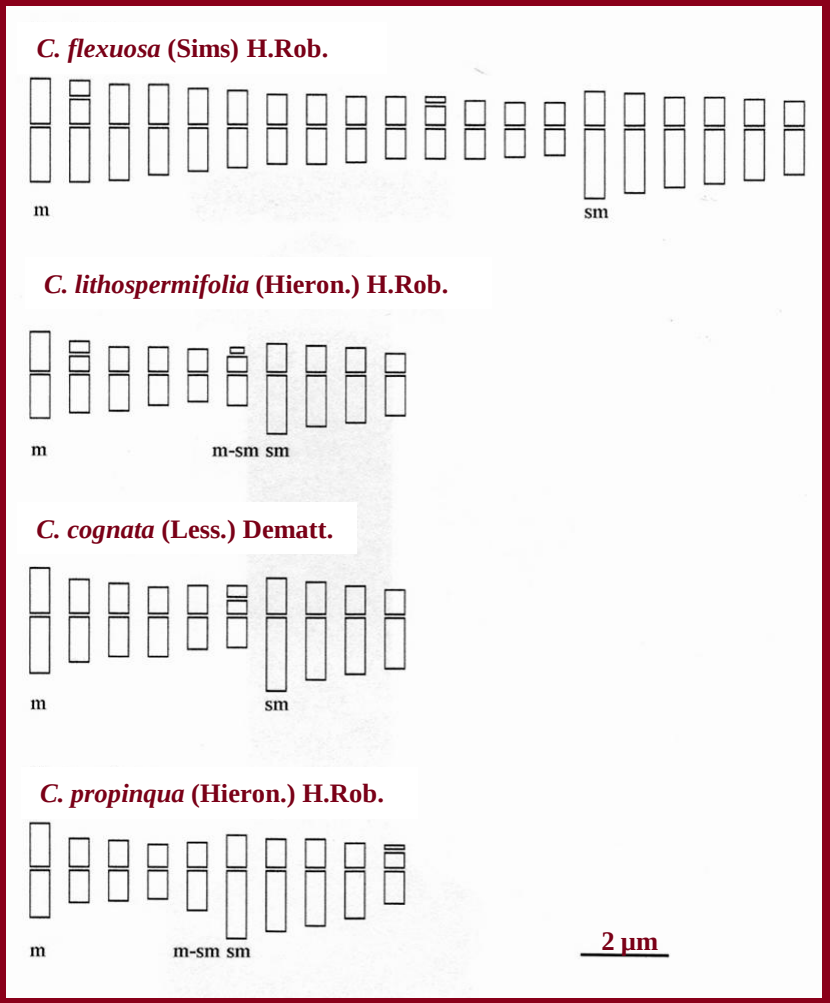
2,5 µm

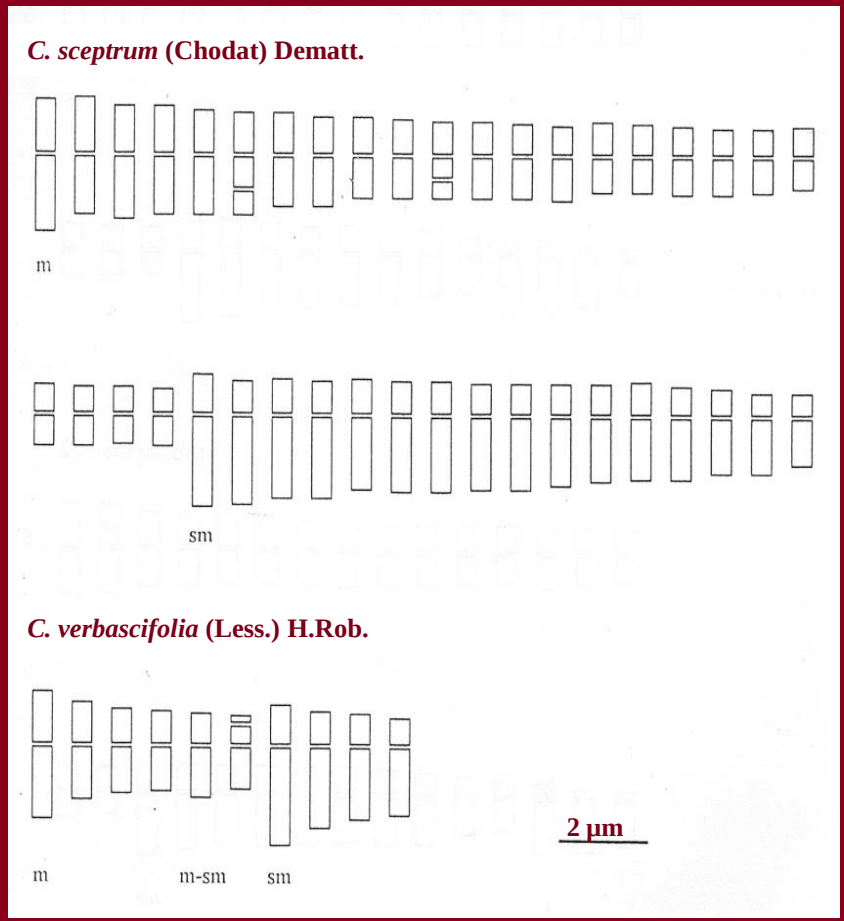


2n=6x=60

2n=8x=80

Chrysolaena





- majority of metacentric chromosomes, accompanied by 4-6 submetacentric pairs.
- chromosome size between 2,1 and 2,6 µm.

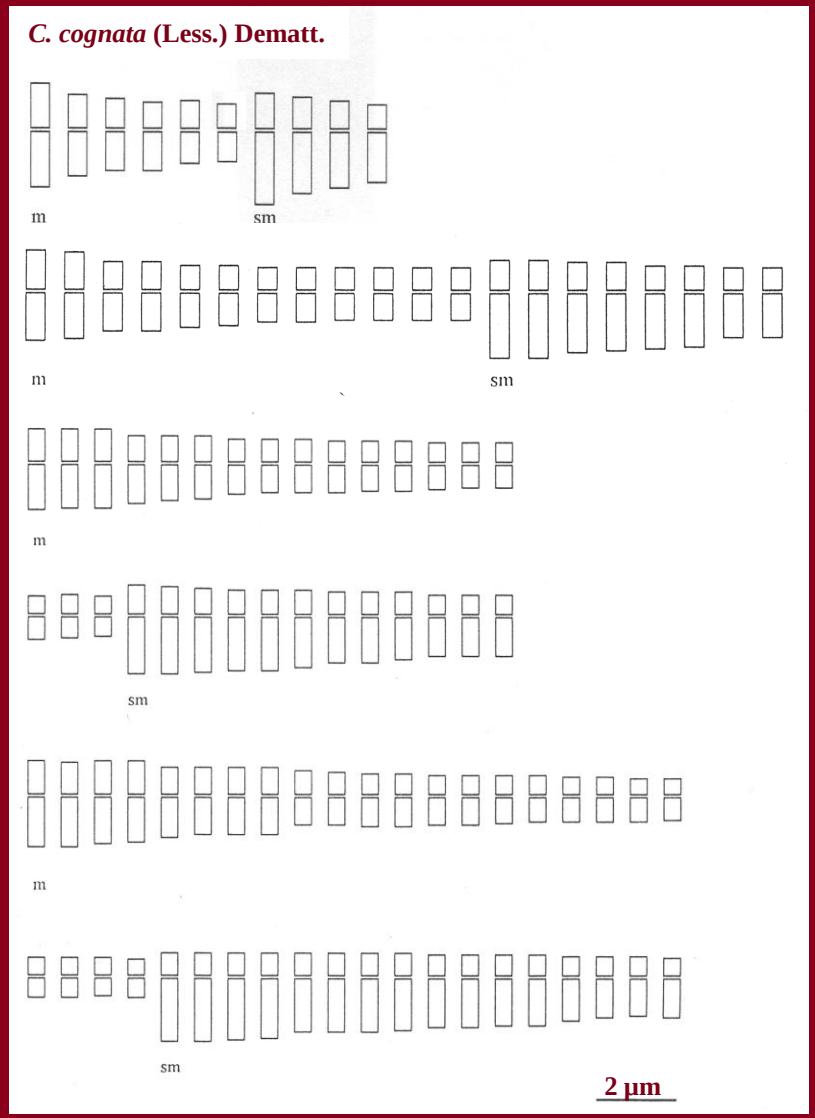
Idiograms of four cytotypes of *Chrysolaena cognata*

diploid
12m + 8sm.

tetraploid
24m + 16sm.

hexaploid
36m + 24sm.

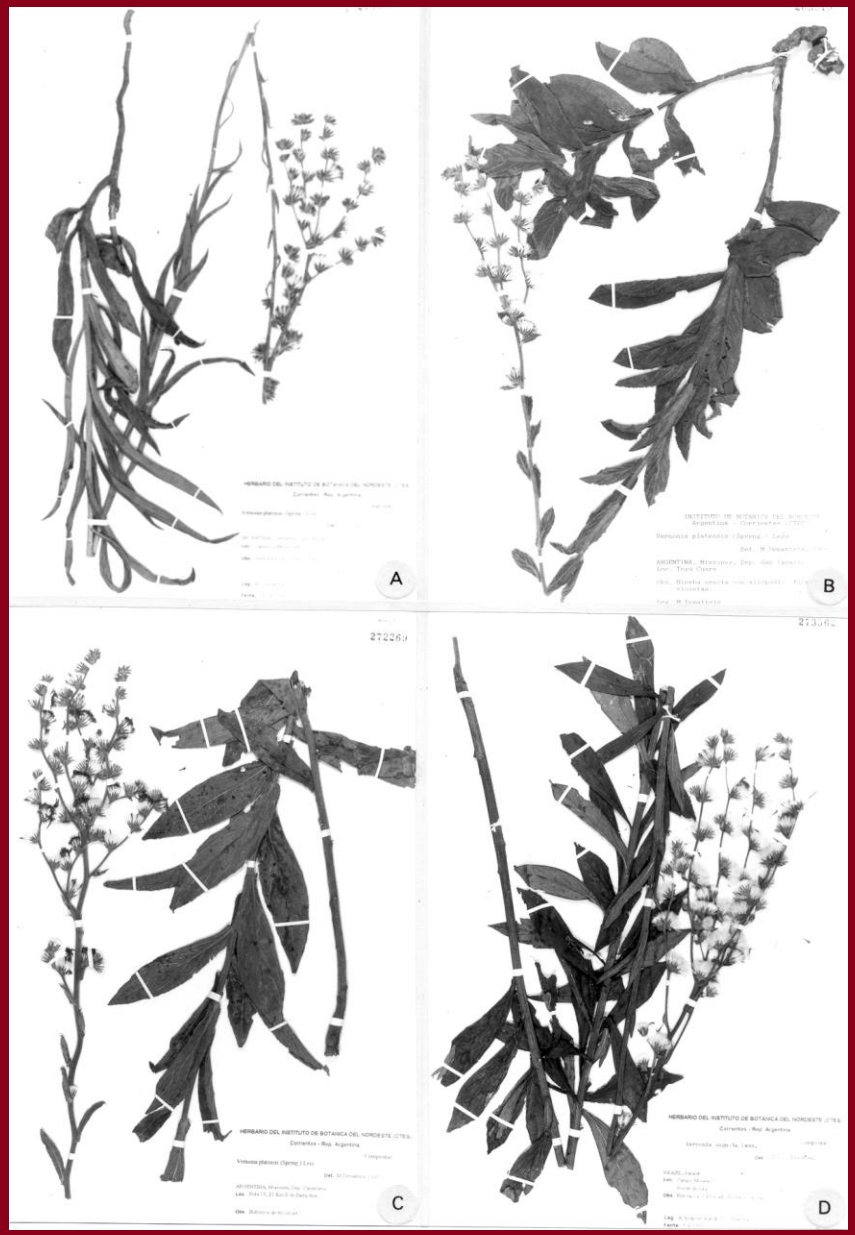
octoploid
48m + 32sm



Morphology of the four cytotypes of *Chrysolaena cognata*

diploid

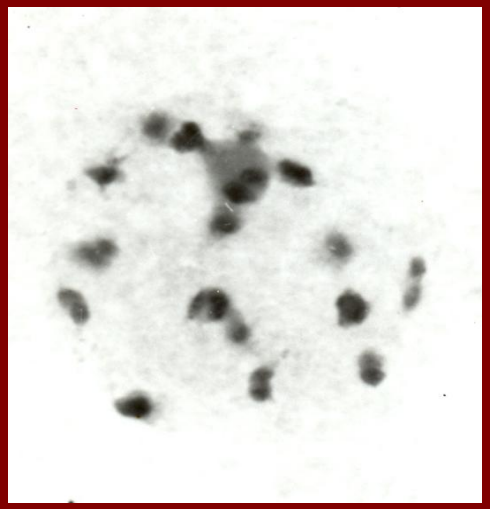
tetraploid



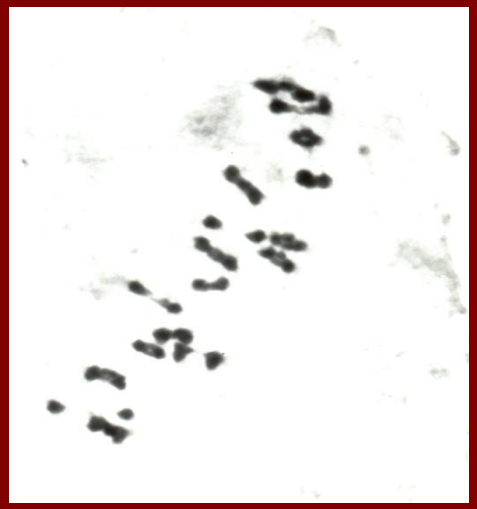
hexaploid

octoploid

Vernonanthura (*Vernonia* subsect. *Paniculatae*) (90 spp.)

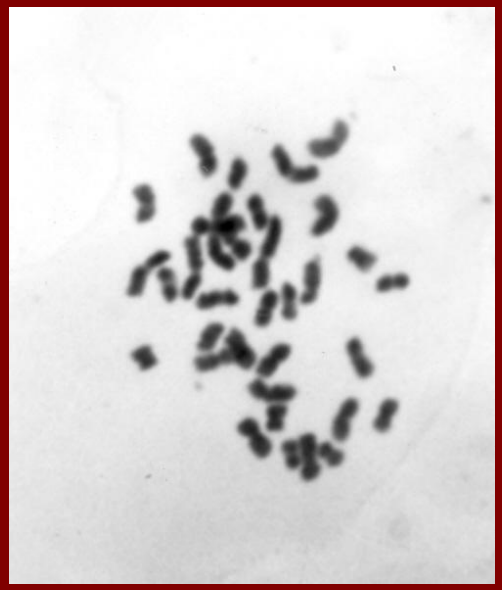


V. nudiflora (Less.) H.Rob.
n=17 II



V. amplexicaulis (R.E.Fr.) H.Rob.
n=17 II

V. nudiflora (Less.) H.Rob.
2n=2x=34

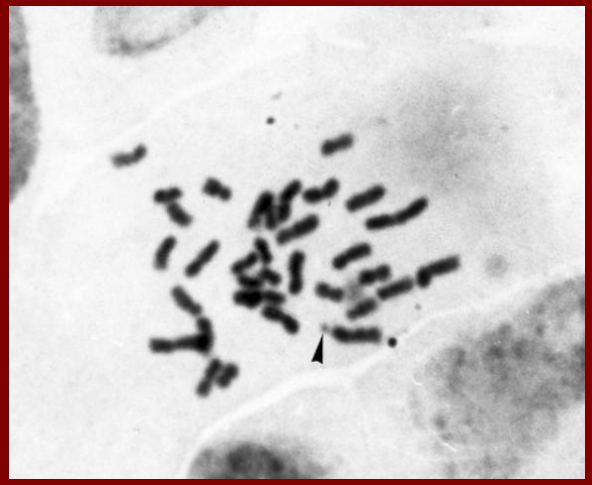


V. chamaedrys (Less.) H.Rob.
2n=2x=34

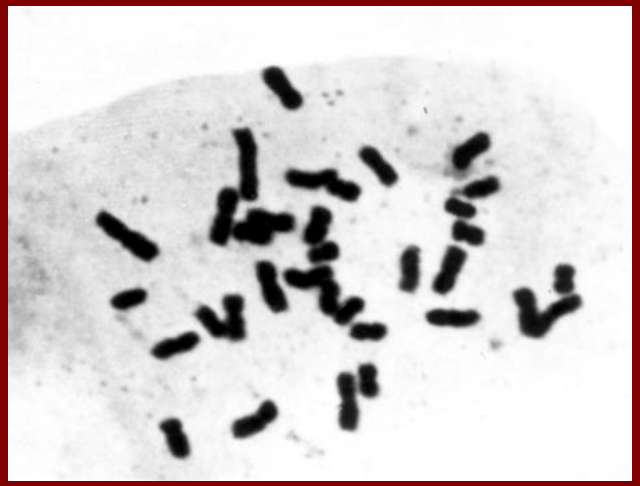
V. squamulosa (Hook. & Arn.) H.Rob.
2n=2x=34

V. ferruginea (Less.) H.Rob.
2n=2x=34

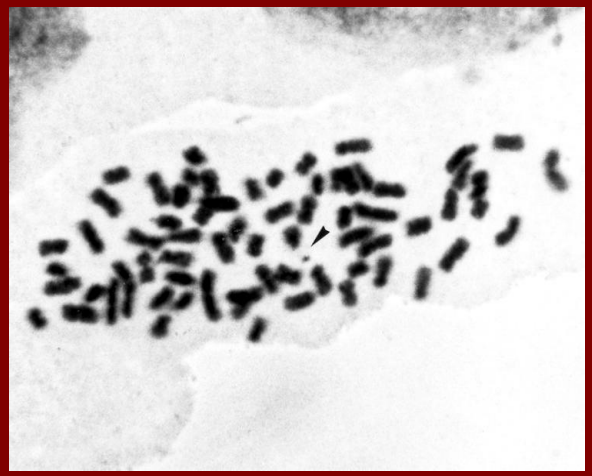
Vernonanthura



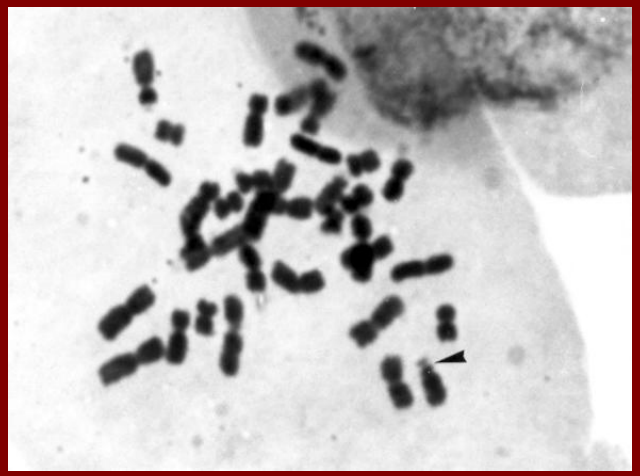
V. loretensis (Hieron.) H.Rob.
2n=2x=34



V. montevidensis (Less.) H.Rob.
2n=2x=34

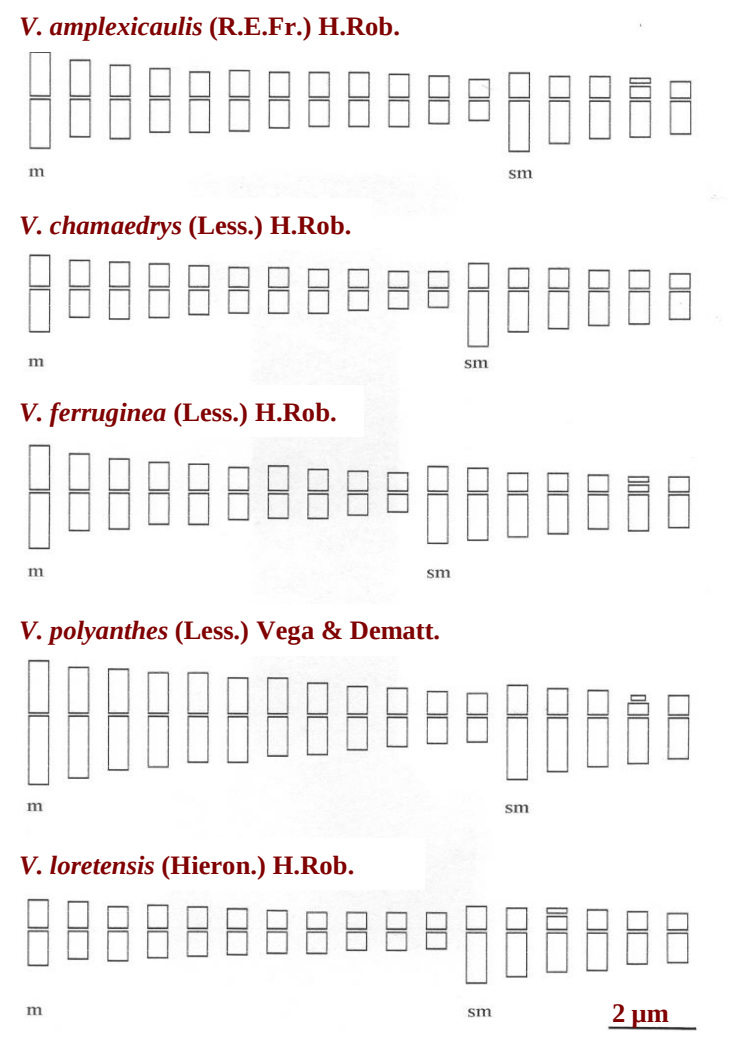


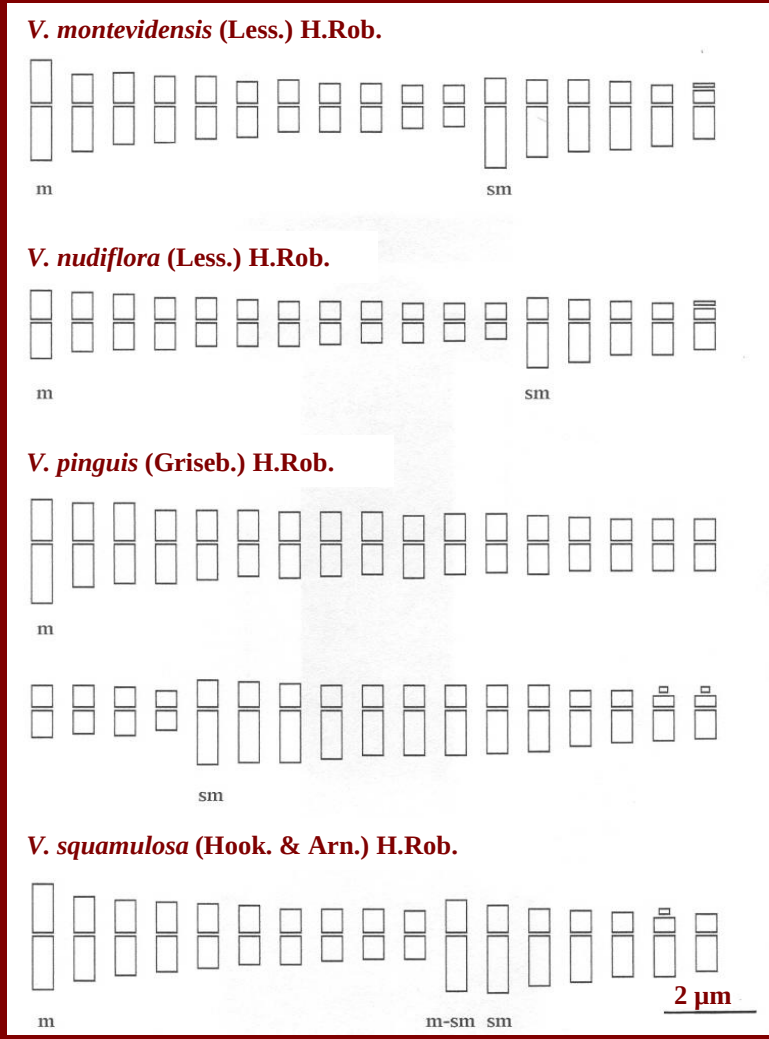
V. pinguis (Griseb.) H.Rob.
2n=4x=68



V. polyanthes (Less.) Vega & Dematt.
2n=2x=34

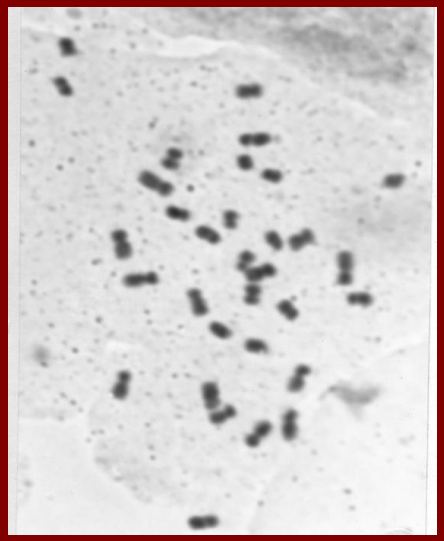
Vernonanthura



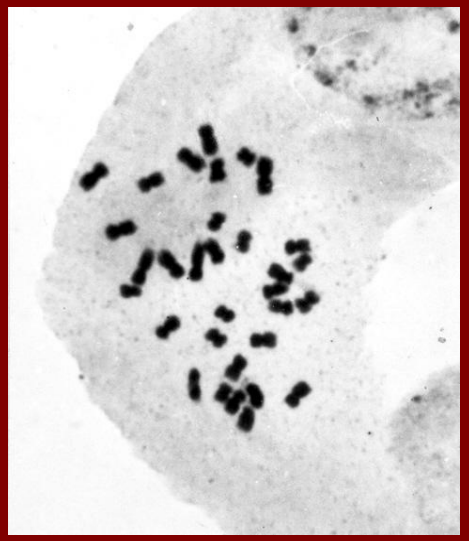


- most of metacentric chromosomes with 5-7 of submetacentric pairs.
- chromosome size between 1,6 and 2,3 µm.

Lessingianthus (*Vernonia* subsect. *Macrocephalae*) (125 ssp.)



L. onopordioides (Less.) H.Rob.
2n=2x=32



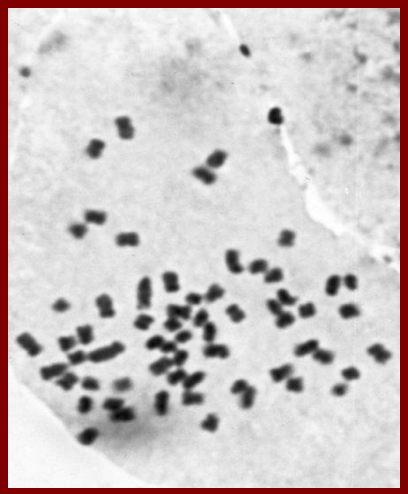
L. brevifolius (Less.) H.Rob.
2n=2x=32

L. coriaceus (Less.) H.Rob.
2n=2x=32

L. durus (Mart.) H.Rob.
2n=2x=32

L. heringeri (H.Rob.) H.Rob.
2n=2x=32

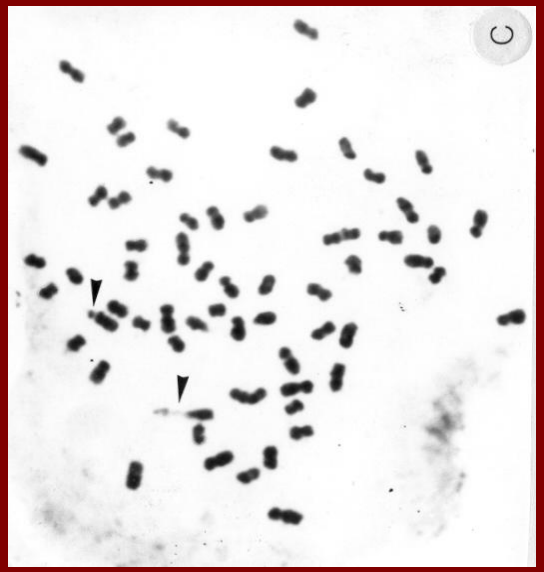
L. saltensis (Hieron.) H.Rob.
2n=4x=64



L. pumillus (Vell.) H.Rob.
2n=4x=64

Lessingianthus

L. polyphyllus (Sch.Bip.) H.Rob.
2n=4x=64



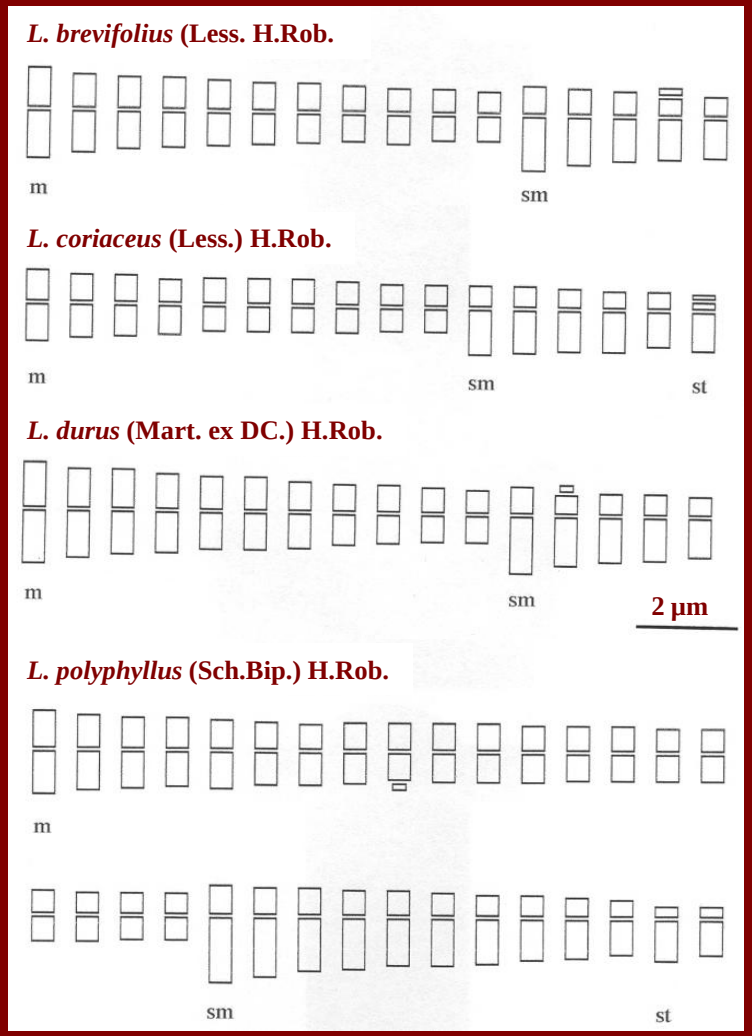
L. mollissimus (D.Don) H.Rob.
2n=4x=64

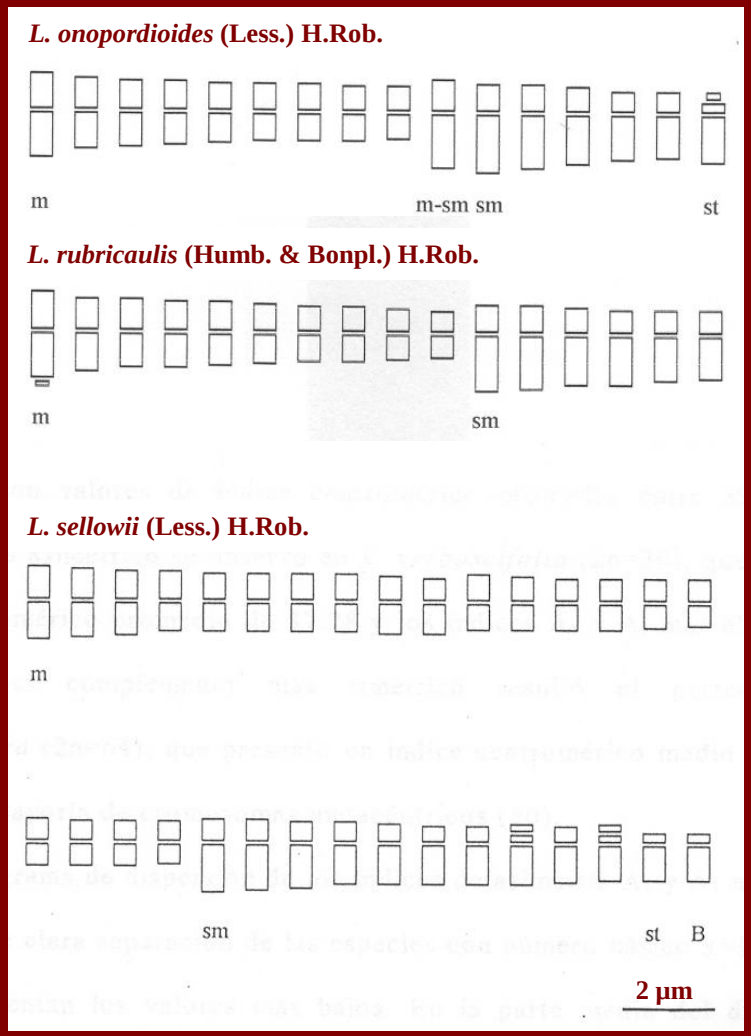
L. pulverulentus (Mart.) H.Rob.
2n=6x=96

L. intermedius (DC.) Dematt.
2n=4x=64

L. teyucuarensis (Cabrera) Dematt.
2n=10x=160

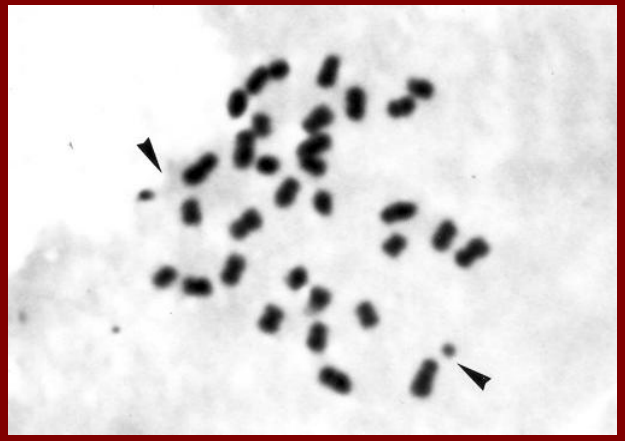
Lessingianthus



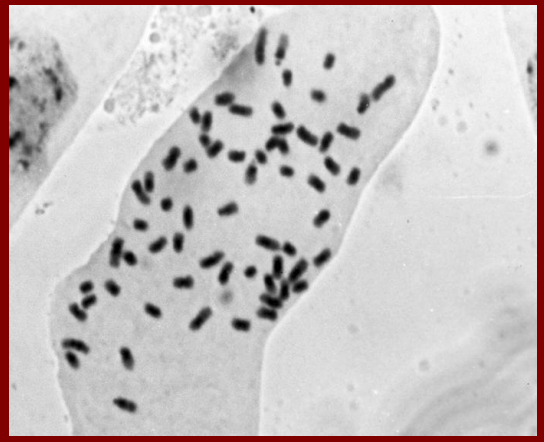


- most of metacentric chromosomes, 3-5 submetacentric and occasionally 1-2 subtelocéntric pairs.
- average chromosome size between 1,30 and 1,80 µm.

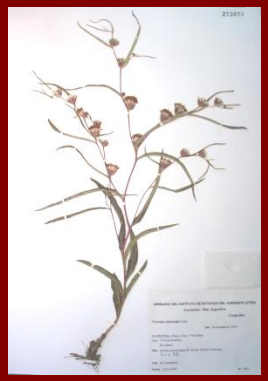
Lessingianthus rubricaulis (Humb. & Bonpl.) H.Rob. *sens. lat.*



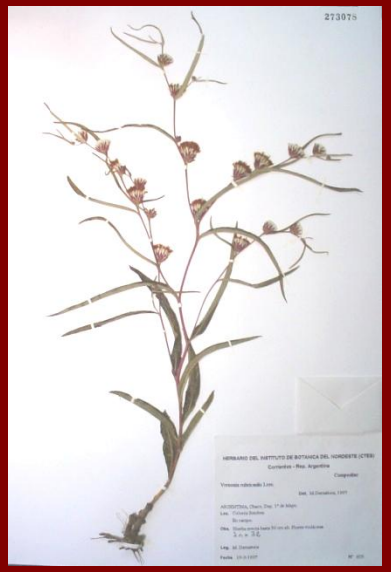
2n=2x=32



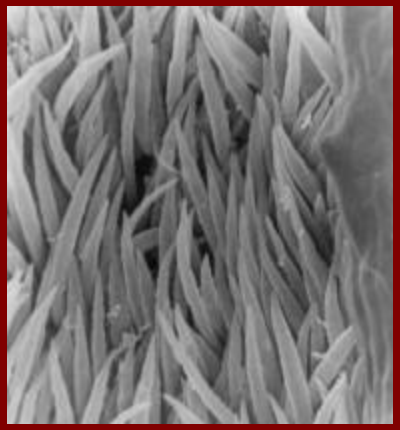
2n=4x=64



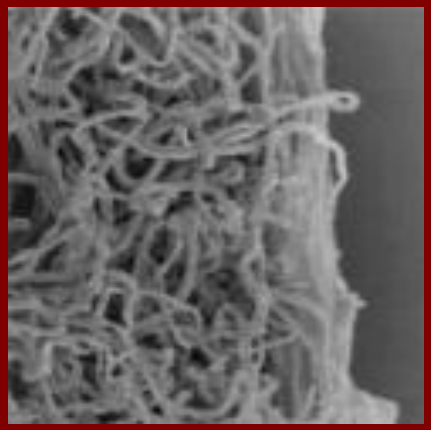
L. pseudoincanus (Hieron.) H.Rob.



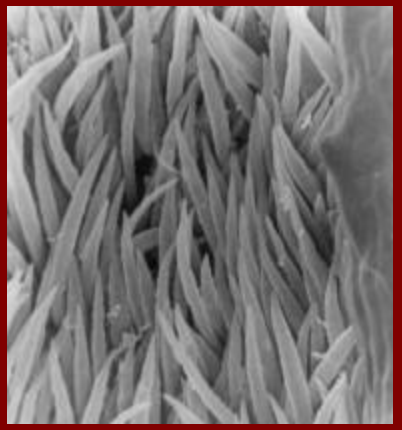
L. pusillus (Dematt.) Angulo



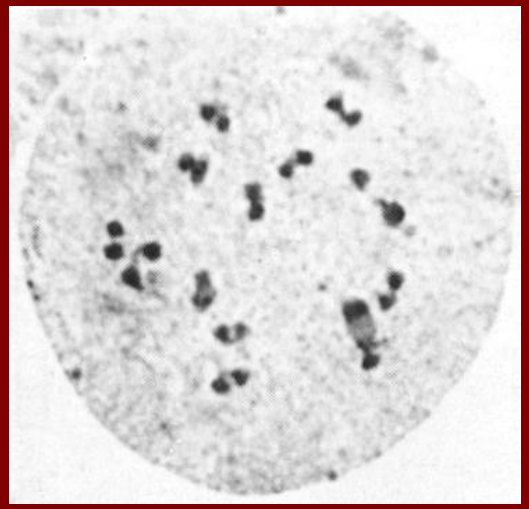
L. laniferus (Cristób. & Dematt.) Angulo



L. rubricaulis (Humb. & Bonpl.) H.Rob.



Lepidaploa (*Vernonia* subsect. *Axilliflorae*) (140 ssp)



L. remotiflora (L.C.Rich.) H.Rob.
n=14 II

L. grisea (Mart.) H.Rob.
2n=2x=30

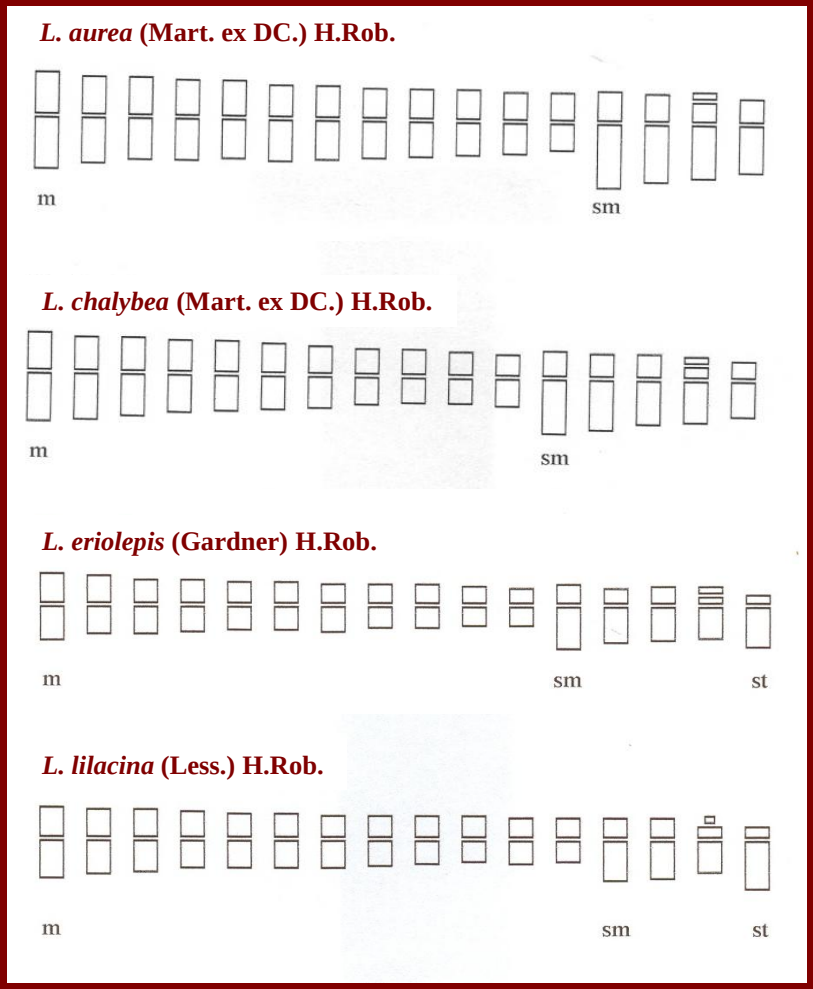
L. aurea (Mart. ex DC.) H.Rob.
2n=2x=32

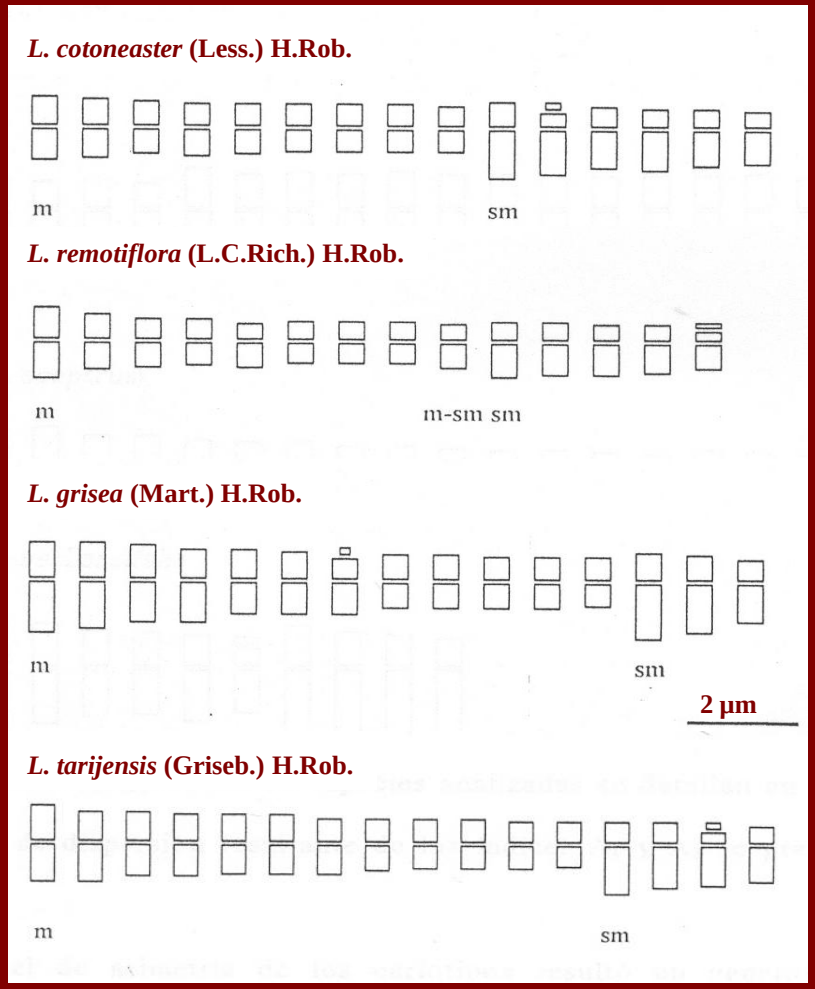
L. eriolepis (Gardner) H.Rob.
2n=2x=32

L. rufogrisea (A.St.-Hil.) H.Rob.
2n=2x=32

L. tarijensis (Griseb.) H.Rob.
2n=2x=32

Lepidaploa



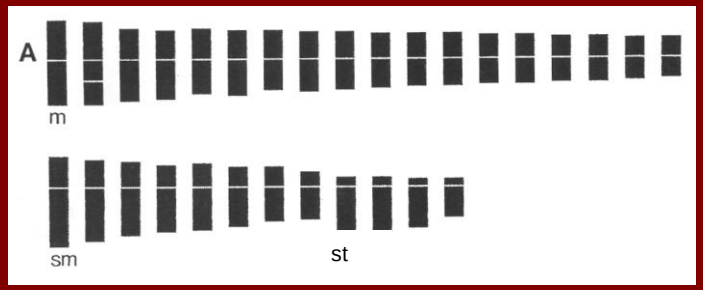


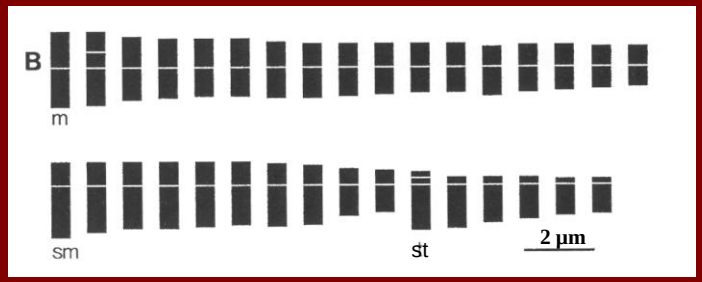
- most of metacentric chromosomes, 3-5 submetacentric and rarely 1-2 subtelocentric pairs.
- average chromosome size 1,6-1,8 µm (x=16), 1,5-1,6 µm (x=15) and 1,1-1,2 µm (x=14).

Cyrtocymura (*Vernonia* subsect. *Scorpioideae*) (5 ssp)

C. cincta (Griseb.) H.Rob. 2n=2x=62

C. scorpioides (Lam.) H.Rob. 2n=2x=66



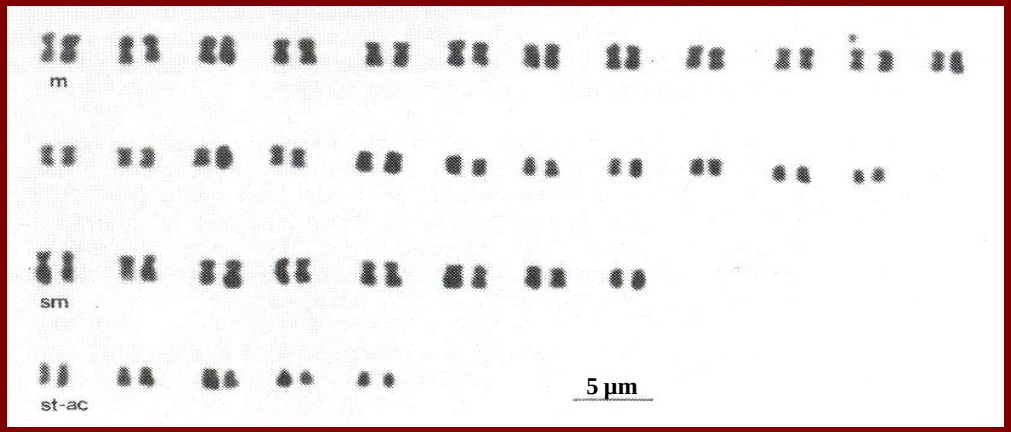


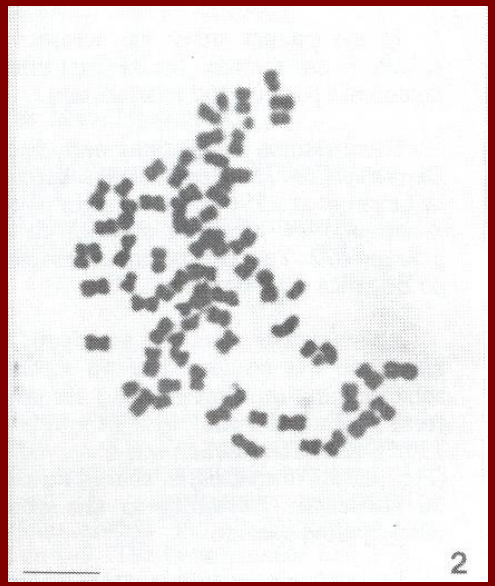
- metacentric, submetacentric and some subtelocentric pairs.
- chromosome size 1,6-1,8 µm.

Dematteis, Bonplandia 10: 155–161. 2000.

Acilepidopsis (*Vernonia echitifolia* Mart. ex DC.) (1 spp.)

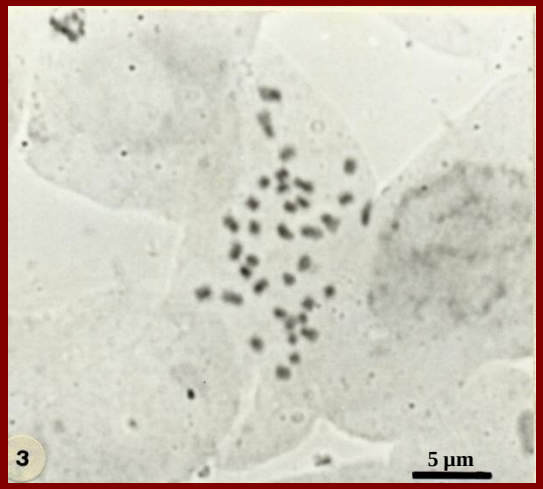
2n=8x=72

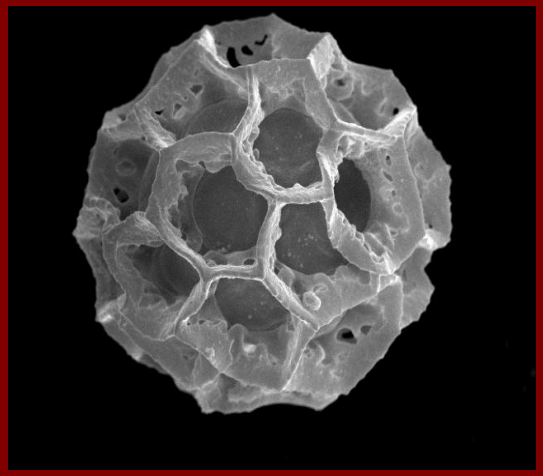




- most of metacentric chromosomes, some submetacentric and several subtelocentric pairs.
- average chromosome size 1,9-2 µm.

Dematteis & Robinson, Phytologia 83:366-370. 1997.





Mesanthophora (*Vernonia rojasii* Cabrera) (2, 1)

2n=4x=36

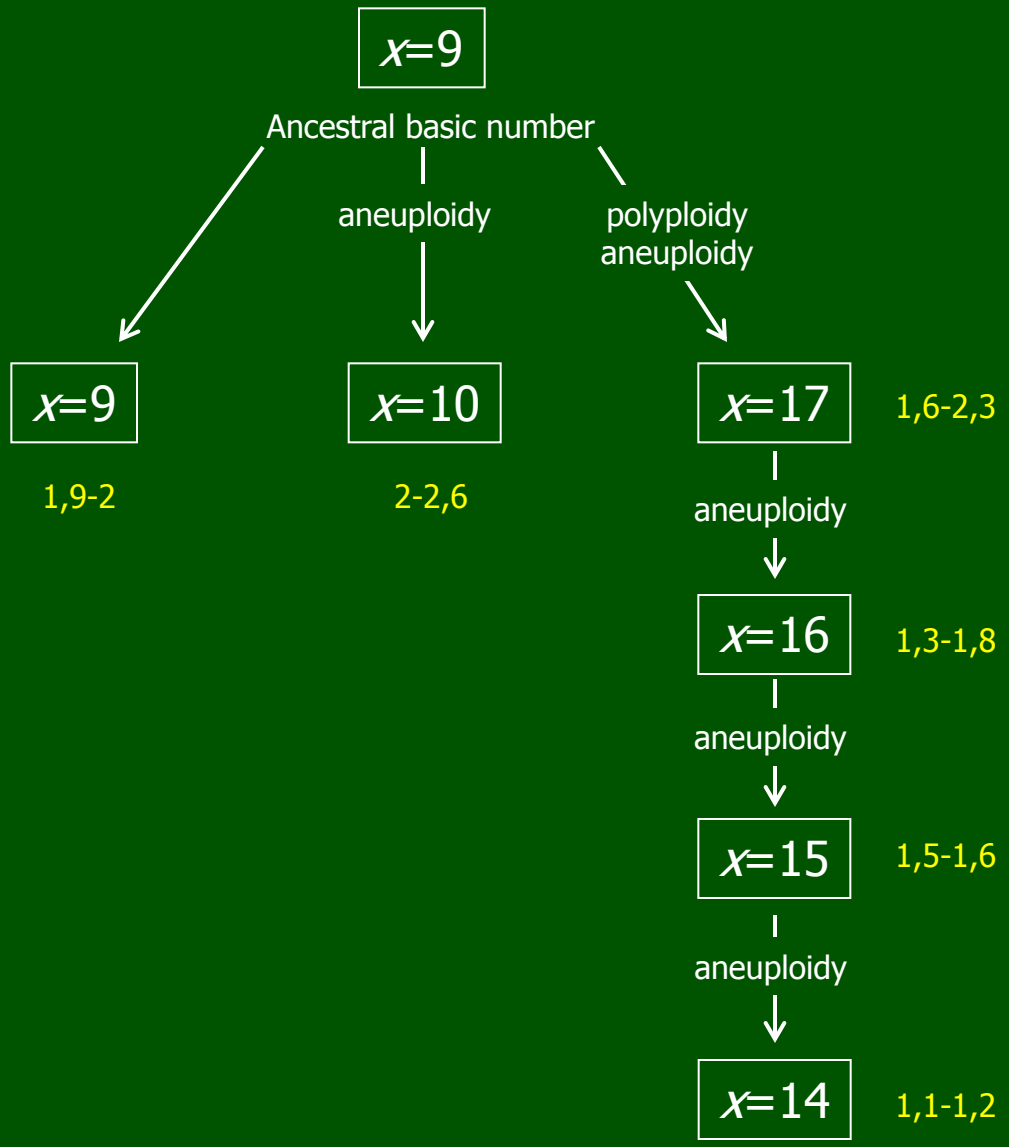
Dematteis & Salgado, Comp. Newsl. 36: 69–76. 2001.

Basic chromosome numbers in different genera

Baker (1873)	**Robinson (1999)**	
subsect. *Macrocephalae*	*Lessingianthus*	x=16
subsect. *Oligocephalae*	*Chrysolaena*	x=10
subsect. *Scorpioideae*	*Cyrtocymura*	x=31, 33
subsect. *Axilliflorae*	*Lepidaploa*	x=14, 15, 16
subsect. *Glomeratae*	*Vernonanthura*	x=17
subsect. *Paniculatae*	*Quechualia*	x=17
	Acilepidopsis	x=9
	Mesanthophora	x=9

Basic chromosome number

Chromosome size



Dematteis, Bot. J. Linn. Soc. 139: 401-408. 2002.

Chromosomes and Taxonomy

Lessingianthus brevifolius (Less.) H.Rob.

- chromosomes can be an useful tool for taxonomic and evolutionary studies in Vernonieae.
- the wide variation in basic chromosome numbers of the tribe make possible to group related species.
- in general, related taxa can be clearly distinguished, because the species show differences in its chromosome complement.
- in most cases, each group presents one or more characteristic basic numbers.
- the single exception is *Lepidaploa*, which is evidently heterogeneous from a chromosome viewpoint, which agree with the morphology of the species.

Chromosomes and Evolution

Lessingianthus barrosoanus Dematt.

- the more primitive species, with basic chromosome number x=9 or x=10, have greater chromosome size than derived taxa.
- the diversification of the tribe was followed by a slow decrease in the size of the chromosome.
- the similarity in the karyotypes within each group, indicates that have occurred very small changes in the structure of the chromosomes.
- polyploidy and aneuploidy have played an important role in the evolution of the tribe Vernonieae.


Muchas gracias por su atención
Thank you for your attention
Obrigado pela atenção