T1992WIL02

CHROMOSOME NUMBER - PLOIDY LEVEL IN SOME PERENNIAL SPECIES OF THE GENUS *Helianthus* L.

Jovanka Atlagić, B. Dozet, D. Škorić
Faculty of Agriculture, Institute of Field and Vegetable Crops,
21000 Novi Sad, Yugoslavia

Summary

The meiosis of 14 perennial species of the genus *Helianthus* differing in ploidy level was analyzed by the acetocarmine method. Chromosome number in the analyzed species was determined on the basis of chromosome coupling at diakinesis.

The results obtained showed that various ploidy levels existed in some of the species. Two populations (1600 and 1603) of the diploid *H. smithii* were found to be hexaploid (2n=6x=102). Besides tetra- and hexaploid *H. strumosus* populations, 6 diploid populations were found (2n=2x=34). In the tetraploid *H. laevigatus*, three hexaploid populations were detected (2n=6x=102). The *H. rigidus* population 1693 was tetraploid (2n=4x=68).

Since various ploidy levels had been found in some wild sunflower species earlier, it can be supposed that new ploidy levels have been detected. On the other hand, it may also be possible that the previous determinations had not been correct.

Introduction

The first results of cytologic analysis in the genus *Helianthus* are related to determination of the chromosome number in cultivated sunflower. Tahara (1915) found that the chromosome number in somatic cells of *H. annuus* is

2n=34. Since *Helianthus* genus is rich and miscellaneous in species, the chromosome number is important for the systematics and taxonomy. Cytotaxonomy of this genus has been studied by many researchers. Already in 1931, Geisler (according to Georgieva, 1976) found that most species of the genus *Helianthus* are diploid (2n=34). Nevertheless, he found tetraploid (2n=68) and hexaploid (2n=102) species. Heiser and Smith (1955) gave the most detailed review of the chromosome number. They reported that some species, such as *H.decapetulus*, are diploid and tetraploid. Smith (1960) confirmed these findings, as well.

Cytologic researches started to be important at the period when interspecific hybridization was introduced in sunflower breeding. Making the systematization of the genus *Helianthus*, Schilling and Heiser (1981) gave the review of the chromosome number for all 49 species and designated the genus as a polyploid complex. Giving the detailed description of the species (morphology, site, etc.), Rogers et al. (1982) introduced the chromosome number for each of them. They also claimed that various ploidy levels existed in some of the species (*H. decapetalus* in di- and tetraploid, *H.strumosus* in tetra- and hexaploid, etc.).

In most of cytogenetic researches, the chromosome number in somatic cells of root tips was determined according to different variants of Feulgen technique. However, already in 1932, Wagner investigated the chromosome number of mother cells in pollen, in the polyploid *H.tuberosus*.

Interspecific hybridization required the observation of meiosis. Many authors such as Whelan (1979 and 1980), Georgieva (1976, 1984 and 1990), Changler et al.(1986) found that diakinesis is the only phase that can be analyzed of all early phases of meiosis. This phase is most suitable for inspection of the chromosome coupling, and enables to determine the chromosomes number in sunflower species and F_1 interspecific hybrids.

The objective of the investigation discussed in this paper was to study the characteristics of meiosis in various ploidy
species which took place in the program of hybridization with cultivated sunflower. In the course of meiosis inspection, we determined the chromosome number in the studied species, as well.

Material and Methods

Six diploid (*H. mollis, H. salicifolius, H. maximiliani, H. occidentalis, H. nuttallii and H. smithii)*, four tetraploid (*H. decapetalus, H. hirsutus, H.strumosus, and H. laevigatus*) and four hexaploid (*H. eggerthii, H. resinosus, H.rigidus and H.tuberosus)* wild sunflower species were used in our investigation. Each species was represented by different number of populations, i.e., collections (totally 54). All collection numbers are deposited in wild species collection of the Institute of Field and Vegetable Crops in Novi Sad. They were collected during the USA expedition in 1980 and 1985 or were obtained from other collections on the basis of seed exchange.

The chromosome number was determined according to the meiosis analysis. Meiosis was analyzed by the acetocarmine method (Georgieva, 1976, 1984, 1990 and Chandler et al., 1986). The mode of chromosome coupling, the number of bivalent and other configurations, and, consequently, the chromosome number of the studied populations, i.e. species, were determined at diakinesis.

Results

In most of the tested species (*H.mollis, H.salicifolius, H.maximiliani, H.ocedentalis, H.nuttallii, H.decapetulus, H.hirsutus, H.eggerthii, H.resinosus and H.tuberosus)*, the chromosome number is identical to that given in literature (Table 1).

The species which have different ploidy levels than those given in literature are separated (Table 2).

H.smithii had been classified to the group of diploid species and both studied populations were hexaploid (Table 2). Two ploidy levels had been determined in *H.decapetalus*, the diploid and the tetraploid. Out of five populations studied, two were tetraploid and three were diploid (Table 2). According to the cytotaxonomy, the haploid chromosome number for *H.strumosus* is n=34 or n=51. Out of 8 tested populations, 6 were diploid, one was tetraploid and one hexaploid (Table 2). *H.laevigatus* had been determined

as tetraploid. In this investigation, however, we identified two tetraploid and three hexaploid populations (Table 2). The tetraploid 1693 was detected in the hexaploid populations of the species *H. rigidus* (Table 2).

Tab. 1 Chromosome number in perennial sunflower species

Sunflower species	N-number of chromosomes acc.to lit.	Analyzed		N-number of chromosomes own finding
		populat.	diakinesis	
H.mollis	17	4	205	17
H.salicifolius	17	1	179	17
H.maximiliani	17	4	104	17
H.occidentalis	17	3	246	17
H.nuttallii	17	3	230	17
*H.smithii**	17	2	53	51*
H.decapetalus	17,34	6	526	17,34
H.hirsutus	34	2	26	34
*H. strumosus**	34,51	6	330	*17,34,51
*H.laevigatus**	34	4	100	34,51*
H.eggerthii	51	1	25	51
H.resinosus	51	1	19	51
*H. rigidus**	51	6	132	*34, 51
H.tuberosus	51	11	111	51

Tab. 2 Chromosome number of perennial sunflower species (different populations) existing in various ploidy levels

Species	Population	Chromosome N-number
H.smithii	1600*	51*
	1603*	51*
H.decapetalus	DEC-B	34
	1926	17
	1884	17
	1887	17
	1882	34
H.strumosus	1623	51
	1934*	17*
	1941*	17*
	1953	34
	1886*	17*
	1895*	17*
	1924*	17*
	1958*	17*
H.laevigatus	1618	34
	1620	34
	1871*	51*
	1874*	51*
	1875*	51*
H.rigidus	72272	51
	47	51
	48	51
	1693*	34*
	1696	51
	707	51

Discussion and Conclusion

Some of the studied species exists in ploidy levels which have not been registered in literature. According to the systematics of Schilling and Heiser (1981) and data of Rogers et al. (1982), the species *H.smithii* is always diploid, 21(2x)=34. In our investigation, both tested populations of *H.smithii* were hexaploid, 2n(6x)=102.

Heiser and Smith (1955) and Smith (1960) had determined the species *H.decapetalus* tetraploid in most cases 2n(4x)=68, but it existed as diploid as well 2n(2x)=34. Rogers et al. (1982) confirmed the results of these cytologic analysis as well. In our investigation, we identified three diploid and two tetraploid populations of *H.decapetalus*, which corresponds with the results achieved by the above-mentioned authors.

Giving the detailed review of the chromosome number of different *Helianthus* species, Heiser and Smith (1955) concluded that some species exist in diploid or tetraploid level, diploid or hexaploid level, but the species *H. tuberosus, H.rigidus and H.strumosus* were found to exist in hexaploid level only. Rogers et al. (1982) had reported the existence of tetraploid and hexaploid level of *H.strumosus*. According to our analysis, however, this species exists in the diploid, tetraploid and hexaploid level. *H.rigidus* species had been found to be hexaploid (Heiser and Smith, 1955; Rogers et al. 1982). We found one population of this species which is tetraploid (2n=4x=68).

The species *H.laevigatus* had been found as tetraploid (Rogers et al. 1982) what was approved for two populations analyzed in our investigation. However, we identified hexaploid level in this species (three populations).

The results of the chromosome number in the analyzed species and identification of various ploidy levels of the same species, which do not agree with the results in literature, require establishing of the next hypothesis:

1. It is known that certain species exist at different ploidy levels, it is possible that we detected new ploidy levels for the studied species.

2. It may be possible that the studied species had not been correctly determined.

Since the identical material (the same location of collection and collector) exists in other centres where wild sunflower species are kept, the taxonomic membership of these species and the chromosome number should be checked.

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