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CYTOGENETIC STUDY OF INTERSPECIES HYBRIDS *H. annuus* × *H. ruderalis*

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Venclavovich (1941) defines *H. ruderalis* as subspecies of cultured sunflower. However, some other authors consider *H. ruderalis* to be a separate species with sin. *lenticularis*. We have used it under that name in our research work.

H. ruderalis is an annual plant. It is a strong plant, well branched out, without a clearly defined central stem. The leaves are large and of the type of the cultivated sunflower. The blossom clusters are small with bright orange tongue-like flowers. The seeds are small and crumble easily. The species is highly resistant to rust (*Puccinia helianthii*). It is easily crossed with cultivated sunflower. The percentage of seeds obtained in their hybridization ranges from 10,01 to 61,80.

In our hybridization work *H. annuus* was used as mother plant (V. Pustovoit used *H. ruderalis* as mother plant).

The first hybrid progeny is intermediary type, but some type tending towards the mother species (fig. 1), another one tending towards the father species, and a third intermediary (fig. 2), where it is difficult to tell which initial form it resembles more. As a rule, the hybrids of the first group were strong, with large leaves and dense foliage. Although they resemble the mother species, they do not repeat it. Of normal fertility, this type forms a normal pollen. Its seeds have a high absolute weight (up to 112,5) and a relatively high kernel percent (76,4 as against 73,4 for the parent variety). Grown in natural conditions, it is resistant to *Puccinia helianthi* and *Plasmopara halstedii*. All these properties render it of interest for sunflower selection.

The hybrids with an intermediary type of heredity tending towards *H. ruderalis* is usually taller than mother plant (sometimes up to 3,75 m), strongly ramified and occasionally resembling a shrub. The hybrids of this group develop after the paternal type in a number of other traits as well: intensive anthocyan pigmentation of stem, well defined nervation of leaves, form and pigmentation of tongue-like blossom. A characteristic feature of this type of plant is that it blossoms considerably later than the mother species, some progeny blossom as late as the end of September and the beginning of October. One such plant blossomed on October 2.

The third group of plants of an intermediary type resemble *H. ruderalis* in habitus, vegetation period, anthocyan pigmentation of stem, as well as seed type, and the cultivated *H. annuus* species in the size and non-ramification of the head. It is interesting to note that the degree of combination of parental

traits as well as that of the manifestation of these traits differs in these plants. Thus, for instance, certain plants reach a height of 3,20 m, taller than the father, and have heads 15 to 20 cm in diameter, i.e. approximating those of the cultivated parent, while others are low (1,20 m) and have heads ranging from 6 to 12 cm in diameter, i.e. like the wild-growing parent.

The cytologic investigation was confined to studying the behaviour chromosomes at meiosis of pollen mother cells. The meiotic analysis comprised the following peculiar features of meiosis: total amount of chiasmata per cell at diakinesis; mean number of ring bivalents per cell in the initial species and the hybrid, and mean number of chiasmata per bivalent and frequency of the different types of chromosome configuration. The effect of the behaviour of chromosomes thus observed upon the obtained functional gametes was recorded through the vitality of pollen in terms of its stainability in carmine, and through the fertility in term of percentage of seeds produced after free pollination of the initial species and hybrids.

The data of meiosis analysis are presented on table 1, 2. Cultured sunflower *H. annuus* has the highest chiasmata frequency (23,88), and hence highest total number of chiasmata of one cell (which is a result of the higher mean frequency of ring bivalent). *H. ruderalis* has lower chiasmata frequency (20,80), while with hybrids we have obtained intermediate chiasmata frequency (21,83), which is closer to that of *H. ruderalis*. The chromosome associations in the investigated hybrid plants of F_1 , show that the chromosomes conjugate almost completely.

The meiosis of pollen mother cells of the investigated plants of F_1 of the first group proceeds normally as a rule. In plant of the group with an intermediary heredity tending towards the paternal type, the reduction division proceeds with minor deviations from the normal. Of the investigated 269 cells in diakinesis, 261 formed 17 bivalent and eight cells - 15 bivalent and one quadrivalent. Among 114 cells in the metaphase, 13 revealed chromosomes of more rapid growth. Greater abnormalities were observed in anafase II. The percentage of residual chromosomes and bridge associations reached here 39.

Even more pronounced was the variety in F_2 in number of traits. Thus, for instance, plants with an intermediary type of heredity, which in F_1 was overpollinated with a similar one of the same progeny in F_2 gave a decomposition in ramification, anthocyan pigmentation, size of raceme, etc... The segregation continues also in the later generation. In F_3 , too, several groups of plants can be differentiated. In certain progeny it is so great that it would be difficult to find two identical plants.

The hybrids of this cross continued to be studied in the later generation, so far we have isolated plants of nearly cultured type in which we are investigating productivity, oil content of grain and resistance to diseases.

CONCLUSIONS

- 1 - *H. annuus* is easily classed with *H. ruderalis*.
- 2 - The variation of hybrids is strongly expressed as regards certain traits: type of stalk, height of plant, size of leaves and leaf stems, shape and colour of seeds, and so on. On the whole, they occupy an intermediary position, resembling more now the mother and now the father.
- 3 - The meiosis of PMC of the investigated plants proceeds normally as a rule. Only those resembling more the paternal species reveal certain deviations.
- 4 - The plants, obtained after the hybridization of these species, have higher oil content of grain compared to the parents and high field resistance to *Puccinia helianthi* and *Peronospora halstedii*.

Table 1 - Meiosis analysis of H. annuus and H. ruderalis and their hybrids

- a) Mean frequency of closed (ring)bivalent per cell,
- b) Mean frequency of hiasmata per bivalent,
- c) Total number of hiasmata per cell.

	a	b	c
H. annuus	6,33	1,40	23,88
H. ruderalis	4,05	1,21	20,80
H. annuus x H. ruderalis	4,28	1,28	21,83

Table 2 - Chromosome associations in H. annuus, H. ruderalis and F₁ hybrids ; mean number for cell and variation*

Material	N° of chromosomes	N° of studies cell at diakinesis	Closed bivalent	Open bivalent	Univalent	Quadrivalent
H. annuus	n = 17	100	6,33(3-10)	10,52(7-14)	0	0
H. ruderalis	n = 17	80	4,05(2- 7)	12,20(10-15)	0	0
H. annuus x H. ruderalis	n = 17	269	4,80(3- 7)	12,80(10-14)	0	8

* Variation is given in brackets.



Fig. 1. Hybrid F_1 plant of *H. annuus* x *H. ruderalis* with a mother type of heredity.



Fig. 2. Hybrid F_1 plant of *H. annuus* x *H. ruderalis* with a father type of heredity.