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GENETIC ANALYSIS OF SOME TRAITS IN SUNFLOWER (*HELIANTHUS ANNUUS* L.)

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The initial material consisted of two Russian varieties of oil sunflower *(Helianthus annuus* ssp. *sativus),* namely "Czernianka 66" and "Karlik 68" as well as of an inbred line *Helianthus annuus florepleno.* The achenes of breeding varieties were exposed to X-rays in order to increase the genetic variability. The doses applied ranged from 5,0 kR to 25.0 kR. Genetic analyses were conducted on mutative lines and sublines of the I_2 X_2 X_3 and I_3 X_3X_4 generations as well as on the inbred line (I_3) *Helianthus annuus florepleno.* The genetic tests included traits important from the viewpoint of breeding as well as those less important in agricultural practice. The latter ones can be, however, correlatively bound with others, directly influencing the yield of achenes and oil.

RESULTS

1. Inheritance pattern of 10 features in *Helianthus annuus* ssp. *sativus.*

„ERECTUM" TYPE

Mutants belonging to the "erectum" type are characteristic for setting petioles at an acute angle to the stem (the angle being less than 45°). These forms do not hang down their heads up to the moment of full blooming. The genetic analysis showed the „erectum" type mutation be conditioned by one recessive gene linked with one or several genes conditioning the lack of hanging heads.

ANTOCYANIN COLOUR IN STEMS, PETIOLES AND LEAFVEINS

Crosses between plants showing a strong anthocyanin colour, displayed almost all over a plant, with anthocynin-less forms, proved

the anthocyanin colour be a dominating trait. In F_2, a 3 : 1 segregation, characteristic for a mono-hybrid, has been observed. Notwithstanding the general consistency with the monomeric type of inheritance, it seems that this trait is modified by genes of weaker activity.

NUMBER OF LEAVES PER PLANT

In the crosses performed, an inbred line ($I_3 X_3 X_4$), derived from the "Karlik 68" variety, was employed. The latter produced in two-years experiments 12.6 leaves on the average, maximum 14.0. The maternal plant, originating from a line of averagely 22.0 leaves, was genetically male-sterile. Plants of F_1 generation had averagely 18.0 leaves, i.e. they were almost indirect in relation to their parents. In F_2 100 plants were analysed, out of which seven had from 10 to 14 leaves, i.e. as many leaves as their parental form. The resulting segregation is close to that characteristic for di-hybrid 1 : 15. Small number of leaves (10—14) occurs in a recessive homozygote. It is undoubtedly a simplified inheritance model of this trait and it related only to genotypes of small leaf-numbers.

„SPOONLIKE" ROLLING OF LEAVES

In two inbred lines derived from the variety "Karlik 68" rolling leaves were observed, showing most distinctly prior to the flowering of plants. Genetic tests revealed this trait be conditioned by one recessive gene.

CURLING LEAVES

Leaf-curling is a character often observed in natural sunflower population. Genetic analysis showed a direct monomeric inheritance of this character ; curled leaves occur in a recessive homozygote.

THICK AND SHORTENED PETIOLES

Two out of the analysed inbred lines had distinctly shortened petioles, wich were firmly fixed to the stem. It was connected as well with the plant height and internode length reduction. A mutative line representing the above mentioned characteristic traits, was crossed with a genetically male-sterile plant of a normal type i.e. long, thin petioles. F_1 hybrids resembled the maternal form ; in F_2 a segregation corresponding with the segregation ratio in the di-hybrid 9 :7 was found. It can be assumed that the occurrence of thick and short petioles is conditioned by two unlinked pairs of alleles of a complementary action.

NUMBER OF LIGULATE FLOWERS

In some inbred lines derived from the variety "Karlik 68" the number of ligulate flowers ranged from zero to a dozen or so. Self-pollinating plants without ligulate flowers gave progeny of variability in respect of this trait. It was observed in the F_1 generation that crosses between the mutated line and that of a considerable number of ligulate flowers resulted in a smaller number of ligulate flowers (the latter have not covered themselves around the capitulum circumference). The segregation obtained in F_2 corresponded with the segregation ratio 9 : 7. Thus the number of ligulate flowers per sunflower inflorescence is conditioned by two unlinked pairs of alleles.

ANTHOCYANIN COLOUR OF STIGMATA

Sunflower stigmata are often anthocyanin-coloured. There is a wide range of the pigment intensity, from anthocyanin-less, through slightly anthocyanin-coloured, up to intense carmine, displayed almost all over the stigma. The genetic analysis performed showed the following :

— anthocyanin colour of stigmata be conditioned by the unlinked pairs of alleles,
— gene B and additionally genes A or C are indispensable to form anthocyanin colour,
— the joint action of genes A and C, in the presence of gene B, is of a cumulative character.

ANTHER-TUBE COLOUR

Anther-tube in sunflower can be coloured yellow, yellowish-brown, up to various shades in black. Genetic tests show the colour of anther-tubes be conditioned by four unlinked pairs of alleles, and thus :

1. The hypothetical gene A brings about the yellow tubecolour in the absence of gene B, C and D.
2. Brown colour results from "covering" the yellow colour (gene A) by a greyish-black colour (genes B, C or D).
3. All shades in black come as a result of the cumulative action of gene B, C and D.

The assumptions presented are of a debatable character and call for more precise analyses as well as for employing the genetically established forms of black-coloured anther-tubes.

GENETIC MALE STERILITY

Male-sterile plants have been found in some inbred lines derived from the variety "Czernianka 66". They produced a few almost well developed but completely unviable pollen grains. Genetic analysis showed a direct monomeric inheritance of this trait and a complete dominance of pollen grains viability.

2. Inheritance of three traits in the hybrids *Helianthus annuus* ssp. *sativus* x *Helianthus annuus florepleno.*

The inbred line (I_3) of *Helianthus annuus florepleno* was used for genetic analyses. Following are the characteristics of certain features of this form :

— branching over the entire stem, central head larger than any secondary heads,

— short ligulate flowers,

— "florepleno" infloresces,

A cross was carried out in which the material plant employed was genetically male-sterile. It showed a lack of branching, long ligulate flowers and a typical sunflower inflorescence.

BRANCHING

Plants of the first generation failed branching. In F_2 there has been obtained a segregation characteristic di-hybrid, 9 : 7.

LENGTH OF LIGULATE FLOWERS

Parental forms differed distincly in the length of ligulate flowers. F_1 plants showed long ligulate folwers. In F_2 a segregation corresponding to the 9 : 7 division ration was found. It is thus assumed that the length of ligulate flowers in sunflower is conditioned by two unliked pairs of alleles.

INFLORESCENCE TYPICAL FOR *HELIANTHUS ANNUUS FLOREPLENO*

Typical inflorescences show a gradual conversion from tubular to ligulate flowers, however, plant devoid of typical tubular flowers are also observed. The first hybrid generation produced "florepleno" type inflorescences. In F_2 the number ratio obtained was characteristic for the monohybrid segregation 3 : 1. It is undoubtedly a simplified model, disregarding the action of genes bringing about minor effects.