T1982GEN11

INHERITANCE OF PLANT HEIGHT AND LEAF NUMBER IN DIALLEL CROSSINGS OF SUNFLOWER INBREDS.

R. MARINKOVIC
Faculty of Agriculture, Institute of Field and Vegetable Crops, Novi Sad, Yugoslavia.

ABSTRACT

M-6/4 had significantly higher values of GCA for plant height and leaf number than the other lines.

Additive and nonadditive component were equally important in the inheritance of plant height. In the inheritance of leaf number, the latter component, including dominance and epistasis, was more important.

The analysis of the components of genetic variance and regression analysis (VrWr and WrW') indicated the presence of superdominance in the inheritance of plant height and leaf number.

Dominant genes (u) were more frequent than the recessive (v) for plant height. The picture was reverse for leaf number. Accordingly, the value of K_D/K_R for plant height was larger than one, for leaf number smaller than one.

INTRODUCTION

Heterosis in sunflower is used via single-cross (SC) hybrids. To develop SC hybrids with high genetic potentials for yield and other agronomic characters, it is essential to have inbred lines with high values of combining ability.

Heterosis in sunflower may be used only if suitable sources of male sterility are available. Male sterility should be incorporated into mother lines, fertility restoration genes into father lines. It is important to determine combining ability of inbred lines as soon as possible in order to select those which carry a large number of desirable agronomic characters.

When developing hybrids, one should have not only a choice of good parents but also the knowledge of the mode of inheritance of certain characters in F_1. The latter may accelerate immensely the breeding work.

As it is impossible to know beforehand the combining ability of certain lines and mode of inheritance of certain characters, diallel crossing is used as a method of gaining this knowledge.

Our objective was to examine combining ability in different sunflower inbreds, mode of inheritance of leaf number and plant height in F_1 combinations, as well as the components of genetic variability and genic effect on different characters of the examined inbreds.

MATERIALS AND METHODS

Six inbreds from different varietal populations were analysed for the inheritance of plant height and leaf number: cms-Ha 99, M-6/4, S-59, R-251, R-387, and R-222.

Diallel crossings including reciprocals were made in 1977. The plants used as mothers were turned male sterile by gibberellic acid.

F_1 combinations and their parents were planted in 1978 after the method of random blocks in three replications. Each basic plot had 20 plants at harvest. Plant height and leaf number were determined at full flower. The inheritance was evaluated by comparing mean values of generations with parents' average (Borojevic, 1965). Combining ability was analysed after Griffing (1956), method 2, model I. The analysis of components of genetic variance and regression analysis were conducted after Jinks (1954), Hayman (1954), and Mather and Jinks (1971).

RESULTS AND DISCUSSION

Plant height.

Superdominance, dominance, and partial dominance were expressed in the inheritance of plant height. The obtained highly significant differences in GCA and SCA showed that both additive and non-additive component of genetic variance were important for the inheritance of plant height in F_1, the non-additive component being prevalent (GCA/SCA= 0.013).

Four inbreds had positive values of GCA, two had negative. M-6/4 x R-387, cms-Ha 99 x R-222, and M-6/4 x S-59 had significantly highest SCA values. M-6/4 x R-251 and M-6/4 x R-222 had negative values of SCA.

Dominant component (H_1 and H_2) was larger than the additive (D). It means that dominant component took the major part of genetic variance for this character. Our results agree with those of Putt (1965).

The value of F was positive, i.e., dominant genes prevailed over the recessive ones, further confirmed by their frequencies (u/v).

The value of $\sqrt{H_1/D}$, larger than one, confirmed the existence of superdominance if all combinations are taken into account.

The value of $K_D/K_R=1.42$, larger than one indicated the prevalence of dominant over recessive genes if all parents are taken into account.

Considering the results obtained, it may be noticed that the expected regression line passes below the coordination center indicating that superdominance is expressed in the genetic control of plant height. The graph VrWr illustrates the relationship between dominant and recessive genes in the parents. R-251 had the lowest variance (Vr) and covariance (Wr) and was closest to the coordination center. It means that this line had the largest number of dominant genes controlling this character. The lines are arranged in the following order according to the value Vr+Wr : R-251, R-222, M-6/4, S-59, R-387, and cms-Ha 99.

Leaf number per plant.

Partial dominance was found in nine hybrid combinations in F_1, intermediacy in three combinations, dominance in two combinations, and superdominance in one combination.

To evaluate the genic effect for the number of leaves, values of combining ability were calculated on the basis of mean values of the parents and F_1 generation. Both additive and nonadditive component of genetic variance were important in the inheritance of leaf number. However, the ratio GCA/SCA indicated the prevalence of nonadditive component. Three lines had positive values of GCA, three negative. M-6/4 had the highest value, R-222 the lowest. There were no significant differences.

The combination S-59 x R-251 had significantly highest value of SCA. Eight combinations had negative values of SCA. The results of SCA showed that R-251 combined well with most of the lines.

Dominant component (H_1 and H_2) was larger than the additive (D) for the leaf number. It means that dominant component took the major part of genetic variance for this character.

The value of F was negative indicating the prevalence of recessive over dominant genes, as confirmed by the value of K_D/K_R which was smaller than one.

The value of $\sqrt{H_1/D}$, larger than one, confirmed the existence of superdominance if all combinations are taken into account.

The regression analysis confirmed the prevalence of non-additive genic action in the inheritance of leaf number per plant. R-387 had the largest number of dominant genes — the point designating this line was closest to the coordination center. R-222 had the largest number of recessive genes and its point was the most distant from the coordination center.

CONCLUSIONS

M-6/4 had significantly higher values of GCA for plant height and leaf number than the other lines.

Additive and nonadditive component were equally important in the inheritance of plant height. In the inheritance of leaf number, the latter component, including dominance and epistasis, was more important.

The analysis of the components of genetic variance and regression analysis (VrWr and WrW') indicated the presence of superdominance in the inheritance of plant height and leaf number.

Dominant genes (u) were more frequent than the recessive (v) for plant height. The picture was reverse for leaf number. Accordingly, the value of K_D/K_R for plant height was larger than one, for leaf number smaller than one.

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T1982GEN12

INHERITANCE OF TRICHOME CHARACTERISTICS IN SUNFLOWER, *HELIANTHUS,* SPP.

W.S. HARADA and J.F. MILLER
Department of Agronomy, North Dakota State Univ., Fargo, ND, U.S.A.

ABSTRACT

Trichome characteristics of length, density, stiffness, and coarseness of *Helianthus annuus* L., cultivar HA 89, *H. argophyllus* Torrey and Grey, a wild species, and their F_1, F_2, and backcrossed progenies were examined using laboratory and field methods of evalution.

The date obtained using the laboratory method of evaluation showed an F_2 segregation ratio of 1:2:1, short:medium:long, for stem trichome length and 3:1, sparse:dense, for trichome density. The data obtained using the field method of evaluation showed an F_2 segregation ratio of 3:1 for trichome length (short:long) and trichome stiffness (erect:appressed), a 9:7 segregation ratio for trichome coarseness (coarse:fine), and a 15:1 segregation ratio for trichome density (sparse:dense). These data indicate that trichome characteristics are simply inherited and controlled by one or two genes, and that additive genetic variance accounted for a major portion of the genetic variation for these traits.

The laboratory method provided more defined data; however, these data agreed sufficiently with those of the field. Therefore, the latter method could be used to select lines with desirable trichome characteristics in a breeding program. The presence of additive genetic variance indicates that selection could be made with relative ease.

INTRODUCTION

Investigation on the genetics of pubescence has been initiated by many scientists on different crops (Maxwell and Jennings, 1980; Painter, 1951; Sprange and Dahms, 1972; Webster, 1975). Leisle (1974) has found that pubescence in durum wheat (*Triticum turgidum* L.) is controlled by three genes, and these genes may be acting in an additive manner to determine length of trichomes. Since this character is relatively simply interherited, Leisle contends that a backcross program can be used to transfer this characteristic to commercial cultivars.

Ringlund and Everson (1968) indicated that in wheat the pubescent character is quantitatively inherited with gene action primarily additive. They also indicated that pubescent density is partially dominant with heritability approximately 50%. Bernard and Weiss (1973) reported that seven genes have been identified that control different trichome characteristics in soybean (*Glycine max* L.). These characteristics were reported to be simply inherited and controlled by either one or two genes. These reports indicate that the pubescent characteristics, independent of crop species, are simply inherited and relatively easily transferred.

MATERIALS AND METHODS

Interspecific hybridization of *H. annuus* L. cultivar HA 89, a cultivated inbred sunflower line was made with a number of plants from a population of *H. argophyllus.* Later, backcrosses of the F_1 to both parents were also made.

Seeds of HA 89, F_1, F_2, and backcrosses to both parents were planted at Fargo, ND at a depth of approximately 20 mm in 1.6 m rows spaced 0.9 m apart with approximately 30 cm between plants within rows. The plants of the *H. argophyllus* parent were transplanted from the greenhouse into the field at the fifth true leaf stage.

Stem and leaf samples were collected when the ray flowers on the main head developed yellow petals. Two thin sections of the epidermal layer of the stem, each approximately