T1972BRE04

FERTILITY RESTORERS

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The Morden sunflower breeding program has the aim of producing genuine hybrid sunflowers making use of the cytoplasmic sterility derived from France and using our own as well as other fertility restorers. I attempted 27 hybrid combinations of this kind for testing this year but seed was rather short of several.

Another change in emphasis in the past few years has been to try to produce earlier hybrids with maturity in the range of Krasnodarets rather than Peredovik. The purpose of this is that to some extent, sunflower production is shifting westward in Canada where earlier maturity is essential.

Although I believe the cytoplasmic restorer system will work, the research for the perfect hybrid still continues using standard methods. If we already had an early, outstanding pair of lines to use in a hybrid, then it could be brought into production very rapidly. However, this perfect combination has not yet been found.

RELIABILITY OF STERILE LINES

Cytoplasmically sterile lines may not be completely reliable under all environmental conditions. When one is classifying for fertility, the fact that "sterile" plants occasionally produce pollen does not help in the interpretation of ratios of progeny in order to understand the inheritance of restoration ability :

Table 1 - Seed set of cytoplasmic male sterile lines in three genetic backgrounds grouped according to amount of seed set when covered with cotton bags for selfing under field conditions at Morden.

Line	Number of seeds set			
	0	1-5	6-10	11 or more
1 365 A	45	49	-	-
1 366 A	41	3	-	-
1 367 A	37	35	6	2

Table 1 shows that source 1 366 A is by far the most reliable line to use. In 1 367 A, for example, one of the plants produced 39 seeds.

In a small scale test using the above three lines at 25 C in the greenhouse and at 30 C and 35 C in a growthroom, 1 366 A proved most reliable again. On the other hand, 1 367 A produced considerable amounts of pollen in the greenhouse and at 30 C, but none at 35 C. Hence, high temperature enhances its reliability.

RESTORER SOURCES

We have in the Morden program seven sources of fertility restorers although most of the work has been done with two of these. In addition, I am convinced that we could find many more in wild sunflowers.

1 338 -

This was isolated from wild Helianthus annuus and appears to be controlled by a single dominant gene as reported in 1970 in Memphis.*

Under field conditions in 1970 the first cross of Krasnodarets onto the heterozygous restorer in a sterile background produced 53 fertile to 30 sterile plants (x^2 for 1 : 1 = 6.37). I am assuming that this is a 1 : 1 ratio and that the excess of fertile plants is due to pollen production by "sterile" plants. This appears to be borne out because, in the following generation, a number of plants produced completely sterile progeny. Further corroborating evidence for a single gene comes from the segregation of 20 families, grown in Florida, which segregated 168 fertile to 172 sterile or an almost perfect fit for a single dominant gene.

This source (1 338) is being backcrossed into Krasnodarets. The third dose of Krasnodarets will be contributed this summer. It provides complete restoration, appears reliable, will be selected for high oil content using N.M.R. and will be selected for rust resistance. The rust resistance comes with the wild source as a by-product, and its relationship to other sources is not known.

From this same material we will also select sterile plants to be crossed with Krasnodarets to produce cytoplasmic sterile lines. This is possible because the original cross was made into sterile cytoplasm. This procedure obviates the need for test crosses. If one desires to get rid of the sterile cytoplasm, the final cross of fertile plants can be done onto Krasnodarets females and then purify for restoration.

1 356 -

The 1970 data reported in Memphis* indicated a single dominant gene for fertility restoration. In 1970, plants classified in the field at Morden produced a ratio of 54 fertile : 31 sterile plants (x^2 = 6.22 for a 1 : 1 ratio). This is almost identical to that of 1 338 and, I suspect that the excess in the fertile class is again due to the same reason as above. Corroboration for this also comes from the following generation in which completely sterile progeny appeared. Further segregating material was grown in Arizona last winter which resulted in ratios that I cannot explain at the moment. The results at Morden this summer will, hopefully, be more explicable.

This source of restoration is also being crossed into Krasnodarets in the same way as described for 1 338. Both sterile lines and restorer lines will be isolated this year.

Armour, South Dakota and Ellendale, North Dakota sources have not been worked with since 1970. One reason for this is that the two sources already described provide complete restoration.

CM 323 and CM 324 -

These restorers behave similarly and because these high oil inbred lines are sister selections, it is very likely that the restorer genes are identical. In the case of 1 338 and 1 356 the wild population source appeared to be homogeneous and homozygous for the restorer genes. In CM 323, not every plant carries the gene or genes, and there is a range in fertility restoration. F_1 plants varied from 60 - 90 % stainable pollen. In the F_2 a number of plants showed complete restoration. Inheritance of the restoration ability is not yet clear and more work is being done this summer.

CM 405 -

This source has not been explored sufficiently to state its inheritance with assurance. Some variability in the F_1 was observed, but completely restored plants did occur. On the basis of limited numbers of plants, it appears to be controlled by a single dominant gene.

Intercrosses of the three Morden sources of fertility restoration (1 338, 1 356 and CM 323) and Dr. Kinman's sources have been made to elucidate the relationship of these genes. This will require another generation of testing.

STERILE LINES:

Ten Morden inbred lines have been sterilized using the 1 366 A source. The fifth backcross will be made this summer. All of these are high oil lines of Peredovik's maturity or slightly earlier. Several contain resistance to rust, verticillium wilt and yellows (Phialophora sp.) . For some we have performance data from hybrid combinations.

In conclusion, we will probably have enough seed of most of the lines described in this paper to distribute limited quantities of seed by early 1973.

BIBLIOGRAPHY

* Henry ENNS, D.G. DORREL, J.A. HOES and W.O. CHUBB - Sunflower Research - A progress report - Fourt International Sunflower Conference - Memphis, Tennesse.