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AGRICULTURAL RESEARCH SERVICE
Crops Research Division
College Station, Texas 77843

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GREETINGS FROM MURRAY L. KINMAN

Conference Participants:

I am very disappointed that I am unable to attend this Fourth International Sunflower Conference because of ill health. There are relatively few of you who have attended all four conferences, and I had hoped that I would be among this group. Some of you have expressed the desire to visit College Station, Texas, after this Conference. At this time it seems unlikely that I will be in the office or field for any appreciable amount of time in the near future. I am sorry to say that I may not be able to visit with you even if you take the trouble of coming to College Station. Also, Messrs. Wade and Lednicky (our technicians) will be so very busy with the peak of the pollinating season that they will not be able to spend an appreciable amount of time with visitors. It is my understanding that Dr. Orellana will be at College Station for a time after the Conference, and I am sure he will be of whatever assistance he can.

I had intended to report to you on the historical background and current status of the cooperative U. S. Department of Agriculture-Texas Agricultural Experiment Station sunflower breeding program at College Station, Texas, and the U. S. Regional Sunflower Yield Tests which have been grown in many locations in the United States and other countries.

Since the initiation of the sunflower program in 1950, the major objective has been the development of high yielding, disease resistant parents for commercial F_1 hybrids of both the high oil and large-seeded types. The introduction of superior high oil, open-pollinated varieties from the USSR may have made the development of hybrids less pressing but has given us no reason to change this objective. Open-pollinated varieties cannot be expected to remain commercially acceptable in highly competitive North American agriculture. Early emphasis was on the use of self-incompatible material as female parents of hybrids. Later, we became interested in simply inherited genetic male sterility. Currently, we feel that the most promise is in the use of cytoplasmic male-sterile lines such as described by Dr. LeClercq at the Third International Sunflower Conference.

My major purpose in writing this letter is to inform you that we have discovered a fertility restoration gene for cytoplasmic male sterility which should greatly facilitate commercial production and reduce cost of sunflower F_1 hybrid seed. This gene, tentatively designated Rf1, was discovered in the high oil, self-compatible, agronomically desirable sunflower line T 66006-2-1, which was developed at College Station, Texas. Three cytoplasmic male-sterile (A) lines and the counterpart restorer (B) lines were received from Dr. LeClercq very late in the spring of 1969. Dr. LeClercq has indicated in letters that he had grown out test crosses of 95 lines and found no male fertility restorer (R) lines among them. Due to late planting and severe weather conditions in 1969, we obtained seed of only the one hybrid involving our material as male parent crossed with the cytoplasmic male-sterile material. The original cross of the cytoplasmic male-sterile line, Cern Ce 2.1.1 C 7.1 (USDA designation PI 343765) X T 66006-2-1 was made late in the 1969 season; the F1 proved to be completely male fertile with near 100% normal stainable pollen in the 1969-70 greenhouse. These F_1 plants were self-pollinated and produced a total of only 39 F_2 seeds, indicating high self-incompatibility; however, excellent seed set was obtained when this pollen was used to pollinate cytoplasmic male-sterile heads. The F_2 and backcrosses to cytoplasmic male-sterile plants were evaluated visually and microscopically during May and June of 1970. Only 27 F_2 plants (in 7 very small populations) produced heads, and a ratio of 15 male-fertile: 12 male-sterile plants was observed. This poor fit to the expected 3:1 ratio is attributed to small sample size. The 144 plants resulting from backcrossing the F_1 to the original cytoplasmic male-sterile parent segregated 57 male-fertile:57 male-sterile; a perfect fit to the expected 1:1 ratio. Crossing the F_1 to another cytoplasmic male-sterile line, A 9345 M 2.1.3.3.3 C 1.1 (PI 343764), resulted in 17 male-fertile:13 male-sterile, an acceptable fit to the expected 1:1 ratio. More evidence for the single gene for restoration may be desirable but does not seem required at present. "Since T 66006-2-1 was selected from a composite cross involving three sources of rust resistance (HA 6, HA 8, and 953-102-1-1-41) backcrossed to Peredovik and since these lines were major sources of rust resistance at College Station, Texas, it seems probable that a relatively high frequency of R lines may be found among the sunflower lines developed by the cooperative USDA-Texas breeding program." Other North American workers have found indications of male fertility restoration for this cytoplasm in wild sunflowers, Helianthus annuus, and in the related species H. petiolaris, but there have been no reports of the mode of inheritance.

Under Texas conditions, all of Dr. LeClercq's cytoplasmic male-sterile lines are self- and backcross-incompatible and seem somewhat lacking in

vigor and very susceptible to disease, making them very difficult to maintain. Under our conditions, effort may be required to combine agronomic desirability and male sterility.

This cytoplasmic male-sterile material appears to behave somewhat similarly to corn (Zea mays) and sorghum (Sorghum bicolor). Close examination under both greenhouse and field conditions at College Station, Texas, has indicated that some cytoplasmic male-sterile plants shed small amounts of pollen and occasionally set a self-pollinated seed. Incidentally, this is also true of genetic male-sterile material under our conditions. Further, we have found that one of Dr. LeClercq's male-sterile lines V 8883 M 6.2.3.2.1 C 4.2 (PI 343763) is segregating for what might be designated as partial male fertility restoration or partial male sterility, with pollen stainability varying from 0 to 95%. The genetics of this situation are not clear-cut, but neither has this phenomenon been clarified in corn or grain sorghum. I think we will find that some inbred lines are good B or R lines, and others are not. If cytoplasmic male sterility in Helianthus behaves in the classical pattern, additional Rf genes should be discovered, and I would not be surprised if additional male-sterile cytoplasms were found.

I will hazard another prediction, perhaps of more practical concern to seed producing companies or institutions. Commercial sunflower hybrids will not be simple (biparental or single-cross) hybrids but three-way (triparental) hybrids or even double-cross hybrids. The female parents of such hybrids will be single-cross hybrids, involving a cytoplasmic male-sterile line and a B (nonrestorer) line of similar agronomic traits. Male parents will be inbred lines, possessing dominant resistance to disease, or two such related lines combined into a line-cross, perhaps by use of genetic male sterility.

Best wishes for a stimulating conference.

Sincerely,

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cc:
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