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A plan for the development of Cytoplasmic-genic Male-sterility in *Sorghum*

by

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Synopsis: Intensive hybrid production programme in *Sorghum* requires development of cytoplasmic-genic male-sterility in many suitable agronomic bases. As most such types happen to be fertility restorers, the straight transference of sterility genes through simple backcrosses is impossible. The process of alternate backcrossing and selfing is time consuming. Therefore, a plan of simultaneous test-crossing and backcrossing is suggested which will ultimately lead to the development of both A and B lines.

Introduction: The discovery of cytoplasmic-genic male-sterility in *Sorghum* (Stephens & Holland, 1954; Mitel *et al*, 1958) has opened up a new line of approach in *Sorghum* breeding, namely, the exploitation of Heterosis. The first step in the commercial hybrid production programme is to cross a number of *Sorghum* types, with the already available male-sterile types and testing the superiority of the hybrids. The limitation here is that the undesirable traits such as the unattractive and poor quality grain, low fodder quality, etc., are also brought into the hybrid from the male-sterile parents. It is, therefore, desirable to transfer the male-sterility to the otherwise valuable types so that they may be used directly as parents of promising hybrids. Further, by developing a number of male sterile lines the scope for combining a veriety of genotypes is highly increased. Development of a male sterile line in a good agronomic base would be easy if the superior agronomic type is different from the male-sterile *Sorghums* only in the cytoplasm, but not in the nuclear genes conditioning male-sterility. Four or five back-crosses following an initial cross with the already available male-sterile type will result in the transference of the male-sterility into the suitable agronomic base.

But many useful types happen to restore fertility in the F_1 hybrid with the male-sterile types. If such types are to be rendered male-sterile, a time consuming process of alternate selfing and backcrossing has to be adopted which may take a minimum period of six years. To cut short the time involved in developing male-sterility in fertility restoring *Sorghum* types, a method of simultaneous test-crossing and backcrossing is suggested and investigation is being carried on to test the attainment of the predicted results. The programme is as follows.

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Method: Male-sterile combine Kafir-60 is an already available male-sterile *Sorghum*. The male-sterility has been found to be controlled by the action of a single pair of recessive nuclear genes with a specific cytoplasm (Maunder and Pickett 1959). Let this be represented as $\frac{mm}{s}$ (the letters on the top of the line represent the nuclear genes and that below the line represents the cytoplasm; N = normal cytoplasm; s = the sterility inducing cytoplasm; m = the recessive gene for male-sterility which expresses itself only in 's' cytoplasm; M = the dominant allele of 'm' which restores fertility). Let the fertility restoring agronomic base be represented as $\frac{MM}{N}$. The F_1 hybrid between the above types will be fertile with the genotype $\frac{Mm}{S}$. The F_1 when artificially emasculated and dusted with pollen from $\frac{MM}{N}$ will give a first backcross progeny consisting of $\frac{1}{2}\frac{MM}{S}$ and $\frac{1}{2}\frac{Mm}{S}$ individuals, all being fertile. Twenty-five plants may be selected at random from this population. Mather (1951) has shown that in a population segregating for a characteristic, in a 1 : 1 ratio, to be reasonably sure that at least one plant with the desirable attribute could be obtained with 99 per cent probability, the minimum number of plants required to be raised is seven. Applying this idea Harrington (1952) has recommended to select seven plants at random from the backcross progeny, which segregates in a 1 : 1 ratio for the character desired to be transferred from the donor parent, but not expressed at the time of crossing, for crossing with the recurrent parent, to be confident that atleast one among them contains the gene for the trait under question. To account for any probable digenic inheritance and to avoid the risk of missing the desired genotype a larger sample of 25 plants is suggested in the present instance. The pollen from these 25 plants will be dusted on 25 male-sterile plants $\frac{(mm)}{s}$. This forms the testcross to find out in the next generation, the carriers of the recessive gene for male-sterility. The remaining unopened flowers of the 25 selected plants from the first backcross progeny will then be hand emasculated and dusted with pollen from the $\frac{MM}{N}$ parent. This forms the second backcross. The seeds from the testcrosses will be sown about ten days in advance to their corresponding backcrosses. Those lines in the test cross progeny which segregate for male-sterility will reveal that their corresponding lines in the second backcross progeny will also segregate into $\frac{1}{2}\frac{MM}{S}$ and $\frac{Mm}{S}$. Twenty five plants

from such lines in the second back-cross progeny will be selected and the process of test-crossing and back-crossing will be repeated until the fourth or fifth backcross, when, in the converted line the recurrent parent genotype is sufficiently reconstituted except that the genes conditioning fertility are in heterozygous condition in a sterility inducing cytoplasm $\frac{(Mm)}{S}$. When the fifth backcross progeny is selfed nearly 1/8 of its offspring will be $\frac{mm}{s}$ and will be male-sterile in phenotype.

The same procedure, but the use of $\frac{mm}{N}$ parent (maintainer for male-sterile combine Kafir-60) as the female in the initial cross, will finally lead to a genotype $\frac{Mm}{N}$ (with the full genome from the cultivated parent under the process of conversion) which, when selfed will throw $\frac{mm}{N}$ plants in $\frac{1}{4}$th of its progeny. A test cross of 50 plants from this progeny with the converted male-sterile of the previous section will reveal the plants of $\frac{mm}{N}$ genotype, as lines derived from such plants will have all the plants male sterile. Such a type of plant forms the maintainer (B-line) for the male-sterile (A-line) developed as per the previous section.

The first back crosses with reference to two agronomic bases viz., Co. 18 and A. S. 3880 have already been effected and the progeny awaits study.

The method, based on the monogenic control of sterility can be modified to suit the actual conditions that may be met with during the course of work.

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