

4. Higher population studies of the  $Rp_1$  locus for resistance to *P. sorghi*.

Previous studies at this laboratory have shown that the corn inbred lines GG208R, Cuzco and Mex 212 carry a single dominant gene that conditions resistance to a specific biotype (90laba) of corn rust *Puccinia sorghi* Schw. Further work showed that genes in GG208R and Cuzco were allelic and were respectively designated  $Rp_1^a$  and  $Rp_1^d$ . The gene in Mex 212 appeared to be either a member of this allelic series or a gene very closely situated to  $Rp_1$ . The data from the following test crosses support the latter view.

| Crosses  | Number of seedlings observed |       | Expected |       | Freq. of Susc.       |
|--|------------------------------|-------|----------|-------|----------------------|
|  | Res.                         | Susc. | Res.     | Susc. |                      |
| (GG208R x Mex 212) x R168<br>( $Rp_1^a$ $Rp_1^?$ ) x rp rp | 6175                         | 8     | 1:0      |       | $13 \times 10^{-4}$  |
| (GG208R x Cuzco) x R168<br>( $Rp_1^a$ $Rp_1^d$ ) x rp rp   | 4168                         | 2     | 1:0      |       | $4.8 \times 10^{-4}$ |

The very low frequency of susceptibles arising in cross number 2 can be due to deletion or mutations. The  $F_1$  generations are currently being studied to measure mutation and deletion frequencies. The frequency of susceptibles arising in cross number 1 involving Mex 212 is almost 2.7 times larger than that in cross number 2. The difference is highly significant. It appears then that in test cross number 1 the frequency of susceptibles also includes crossover events. If this is true, then corn chromosome number 10 has a region bearing several genes close to one another conditioning resistance to biotypes of corn rust.

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1. Protogyny and male sterility in maize.

A large collection of maize germ plasm from India, North Central and South America, Caribbean and other maize growing regions of the world has been collected under the Coordinated Maize Breeding Scheme at this center. Inbred lines developed from such wide germ plasm have been screened and are being used for production of various hybrids. During a study of this material, it was discovered that some inbred lines

frequently showed the presence of some protogynous plants in their progeny. These included among others, Cos 302-A2-1-#-2-#-# and Cau 303-1-f-f, developed from the Colombian Varieties Costeno Blanco and Cau 303; G733-A130-6-#-# developed from Funks Hybrid G733 of U.S.A.; and some  $S_1$  lines developed from the advanced generation of a released double cross, Ganga Hybrid Makka 101.

The protogynous plants of Cos 302 and Cau 303 lines when crossed with G733-A130-6-#-# produced a large number of male sterile plants in the progeny. The actual count of male sterile to male fertile plants in the progeny of one such cross (Cau 303-1-f-f x G733-A130-6-#-#) was 30 Male Sterile:11 Male Fertile. Such male sterile plants obtained earlier in the progeny of Cos 302-A2-1-#-2-#-# x G733-A130-6-#-# (designated as  $Ms_x$ ) were crossed back to the pollinator inbred line, an unrelated single cross and some of them were allowed to open-pollinate. The counts of male sterile and male fertile plants obtained in each progeny are given in the table below:

| Pedigree                        | Male Sterile | Male Fertile |
|---------------------------------|--------------|--------------|
| $Ms_x$ open-pollinated          | 50           | 20           |
| $Ms_x$ x unrelated single cross | 43           | 7            |
| $Ms_x$ x G733-A130-6-#-#        | 15           | 9            |

Similarly male sterile plants were observed in the progeny of the protogynous plants from two  $S_1$  lines isolated from Ganga Hybrid Makka 101, i.e. GHM 101-37 and GHM 101-44. Open-pollinated progeny from these male sterile plants showed three kinds of plants--male sterile, protogynous as well as protandrous. Some selfed progenies of protogynous plants, however, gave only protogynous and protandrous plants.

As early as 1924 J. H. Kempton reported an inherited protogynous condition in a pop corn variety from Spain and also found the presence of male sterile plants in the segregating generation following a cross with a protandrous variety of maize. Kempton further remarked, "It seems probable that proterogyny in maize is the result of a variable expression of a male sterile condition, the variability being brought about through the interaction of modifying factors."

Recently Noble and Russell (Crop Science, 1963) have reported that in backcross progeny and in recovered "Rf Rf" lines with T type cytoplasm it is frequently observed that the pollen shedding is delayed relative to silking date. Similarly, in single crosses with T type cytoplasm of "Rf Rf" lines the interval between pollen shedding and silking has been noted to be decreased (i.e., extent of protandry is decreased) as compared with crosses of these lines with normal cytoplasm. This is due to a delay in pollen shedding rather than earlier silking and sometimes may even result in pollen shedding taking place after silking has occurred in hybrids with sterile cytoplasm.

These results indicate either an incomplete dominance of the Rf, fertility restoring factor (Noble and Russell, 1963) or as Duvick reported (Genetics, 1956) there may be modifying or minor fertility restoring genes which affect the fertility restoration in such a way that pollen shedding would be delayed.

The observations described by the present authors seem to indicate that in nature sterile cytoplasm can be detected, as expressed in the form of protogynous condition where a complete set of fertility restoring genes and the modifiers are not present to affect normal and timely development of pollen. The pollen development is therefore delayed and results in a protogynous condition. The protogynous marker is worth being explored and may be a valuable tool for identification of sterilizable cytoplasm. Experiments are in progress to throw more light on the exact nature of gene-cytoplasm interaction resulting in the protogynous condition, and to confirm the above hypothesis.

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## 2. Primitive maize in Sikkim.

Primitive maize types were reported from the hill country of Assam and Burma by Anderson (1945), and Stonor and Anderson (1949). More recently, certain peculiar varieties, occurring in Central Nepal, have been described by Ono and Suzuki (1952). The Indian Agricultural Research Institute has been conducting a survey of maize germplasm in the northeastern Himalayas and the mainland of India. These studies have revealed that a wide spectrum of genetic variability in maize exists in the northeastern Himalayas, while the northern plains and peninsular India are characterized by a lack of such genetic divergence.

Among the collections from these regions, those from Sikkim present strikingly primitive features. A detailed morphological study has been made of two such types; physiological, genetical and cytological investigations are in progress. The distinctive morphological characteristics of Sikkim Primitive 1 (SP 1) are presented below:

Plant Characters: SP 1 is a pop corn. In its native habitat the plants attain a height of 130 cm to 200 cm. Each plant has a central stem and two to four tillers. Each stem or tiller terminates in a drooping tassel and bears from four to six ears. The lowermost four to five internodes are highly condensed and are from 2.2 cm to 5.0 cm. in length. The main stem bears about 13 leaves. The leaf bearing the best developed ear has a length and width of 57.0 cm and 5.6 cm, respectively. The venation index is about 2.5.

Tassel Characters: The tassel is drooping and has on an average five primary and seven secondary branches. The condensation index is 1.05. The basal end of the lowermost one to two primary branches bear from 10 to 20 functional pistillate flowers. These ultimately develop viable seeds.