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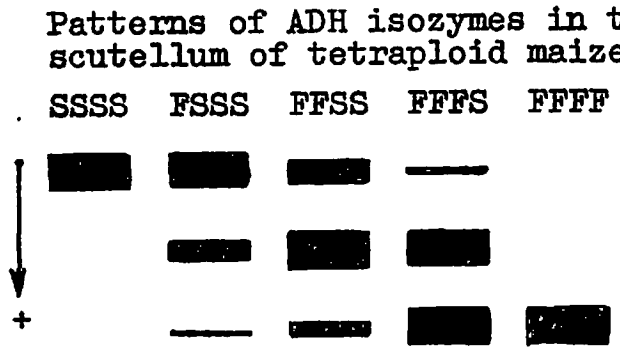
Comparative studies on the expression of Adh in the scutellum of diploid and tetraploid maize — The tetraploid of Adh-F Adh-F/Adh-S Adh-S genotype is an advantageous experimental model for investigation of the regulation of activity at the Adh locus, which controls alcohol dehydrogenase (Schwartz, D., Science 164:585, 1969). When the duplex FFSS is self-pollinated, the offspring are of five genotypic and phenotypic classes which segregate in a 1:8:18:8:1 ratio. On zymograms each of the five genotypic classes is identified by the comparative staining intensity of isozyme bands (Figure). At equal activities of the F and S alleles,



Patterns of ADH isozymes in the scutellum of tetraploid maize.

which specify ADH-F and ADH-S protomers, the dimer molecules ADH-F ADH-F, ADH-F ADH-S and ADH-S ADH-S should be formed in a ratio of 56.3:37.5:7.2 percent (9:6:1) for the FFFS triplex, a ratio of 7.2:37.5:56.3 percent (1:6:9) for the FSSS triplex and a ratio of 25:50:25 percent (1:2:1) for the duplex. Quantitative densitometer measurements of zymograms showed a ratio of 49:42.3:8.7 percent for the FFFS triplex, a ratio of 4.1:31:64.9 percent for the FSSS triplex and a ratio of 32.1:50:17.9 percent for the duplex. These ratios are easily explained on the assumption that the S allele is 1.3 times more active than the F allele; that is, the activity of the enzyme is regulated at the level of transcription. This explanation is in accordance with Schwartz' hypothesis on a limiting factor that is necessary for transcription and for which the alleles compete with different degrees of effectiveness (Schwartz, D., Genetics 67:411, 1971). It was shown that the intensities of the isozyme bands in the duplex FFSS and the diploid heterozygotes FS are identical. This demonstrates that the ratio of the activities of the alleles does not change when cells are transferred to another level of ploidy. The presence of all five phenotypic classes indicates that all four alleles of the Adh locus are active in a tetraploid cell. We have reported elsewhere (Levites,

E. V., and S. I. Maletzky, M.G.C.N.L. 48:63, 1974) that the activity of ADH in diploid and tetraploid plants homozygous for the F allele is the same. However, because the cell volume in tetraploid plants is about twice that in diploid plants, the enzyme activity per tetraploid cell should be twice as high.

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Genetic control of meiosis: mutations affecting meiosis — Meiotic mutants should help to focus attention on single events in the process of meiosis and on specific aspects of the regulation of meiotic systems. Two meiotic mutants controlled by recessive genes were investigated. They were obtained after seed treatment with chemical mutagens (N-nitrosomethyl urea).

Desynaptic mutant: The 44 normal:15 desynaptic plants in the M_3-M_4 segregating progenies indicated that the meiotic irregularities are under the control of a single recessive mutant gene (dy*-G). (Ed. note: Dr. Golubovskaya proposed to use the symbol ds, which would be subject to confusion with Ds; dy*-G is suggested in view of parallel effects with the mutant described by Nelson and Clary, J. Hered. 43:205-210, 1952). Analysis of meiotic prophase I demonstrated all stages: leptotene, zygotene and pachytene. However, as early as zygotene the pairing chromosomes had desynaptic regions, which were more distinct at pachytene. It was found that at diakinesis most homologous chromosomes lie apart and very few open bivalents are formed. The mean numbers of bivalents and univalents at MI were 0.6 and 18.8, respectively.

Chromosome distribution at AI was irregular. Ten + ten chromosome distributions were observed in only 15.2% of 131 cells examined. Other cells showed no regularity in chromosome distribution. Second meiotic division was normal, and all the observed irregularities were the consequences of anomalies in chromosome segregation during first division.

Only 15% of the tetrads looked normal at the end of meiosis. The mutant plants were completely sterile. This desynaptic type of meiotic mutant is frequently observed among different plant species.

Mutation causing the absence of first division (Genetica, in press, 1975): Mutant plants exhibit characteristic meiotic peculiarities. (1) Prophase I of meiosis (leptotene, zygotene, pachytene and diplotene), including the pairing of homologous chromosomes, is absent. At the stage which presumably is diakinesis, all 20 chromosomes lie separately, resembling the mitotic condition. (2) The first meiotic division is of a mitotic type; the 20 univalents are arranged in an orderly manner along the equatorial plate at MI, and the 20 chromatids separate and pass to each pole at AI. (3) Although the centromeres have divided in the first division,