15. Evidence of increased mutation frequency in presence of homozygous knob-10.

A homozygous knob-10 stock which was used as a male parent gave a high frequency of R^g mutants in X-ray and ultra-violet treated plants, and in untreated plants (Genetics 1955). Since the frequency in treated plants was no greater than that in the control, the increased rate of mutation was not attributed to the effects of radiation. At that time there was no evidence available of high mutation rate in female gametes, since heterozygous knob-10 is commonly used in connection with the study of unequal crossing-over.

Subsequent experiments have confirmed this high mutation frequency in female gametes. The compound g R^r K/g R^r K, in 5711 tested gametes, yielded 17 colorless seeds. In plants heterozygous for K-10, only 21 mutants occurred among 104,853 gametes tested. Thus the mutation rate for R in plants of K/k constitution was 29.8×10^{-4}, while in plants of K/k constitution the rate was 1.9×10^{-4}. These data do not come from sib comparisons.

The depression of R mutation rate in the presence of heterozygous knob-10 could be attributed to the presence of a modifier of mutation in homozygous knob-10 stocks. Alternatively, it could be due to an increase in the rate of unequal crossing-over. It is possible that pairing of homologous regions distal to R in K/K may favor unequal crossing-over, as it is known that heterozygous K-10 considerably reduces normal crossing-over between R and the end of normal chromosome 10. The homozygous knob stock, which was used, was not marked to determine unequal crossovers.

Several K-10 cultures including compounds marked for identification of unequal crossovers were grown in last summer's detassel plot in order to determine the extent to which mutants in homozygous K-10 plants are due to unequal crossing-over rather than to gene mutation. The modified knob-10 chromosomes were used in compound with a normal knob-10 to serve as a distinguishable marker distal to R. In addition, plants were grown which would give a direct comparison of seed-color mutations in K/K versus K/k sibs, and in K/k versus k/k sibs.

The following table presents the mutation rates which were found for each of these knob-10 compounds. The mutants will be examined cytologically this summer.

Culture	Population	Number Mutants	Mutation Rate (10^{-4})
K/K	5,711	17	29.8
K/k	104,853	21	1.9
K_s/k	34,478	13	3.4
K_o/k	130,030	25	1.9
K_o/k versus k/k	146,825	41	2.7
K_s/k versus k/k	77,200	24	3.1
K/K_o versus K/k	39,368	8	2.3
K/K_s versus K/k	9,543	3	3.1

K/K_s versus K_s/K	38,820	34	8.7
K/K versus K/K_o	43,095	31	7.1
K/K_s versus K_s/K_o	29,473	19	6.6

These data clearly show a low frequency of mutation in the presence of heterozygous knob-10 and in sib comparisons of types K/k versus k/k and K/K_o versus K/k, which is essentially the same in knob composition as K/k versus K/k. It is also evident from these results that the mutation rate is consistently high, with the exception of one cross, when one of the two genotypic classes includes homozygous K-10. However, it is not as high as it is expected on the basis of the rate observed in plants (29.8×10^{-4}).

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