of 4.6% among the progeny, or in one kernel out of 21.8 (average). After counting chromosomes in root tips, eight plants out of a total of 121 had two supernumerary B^4's (see MNL 1967).

Among the Su kernels, one out of 8.7 (average) is expected to have two B4's in the embryo.

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5. Location of the E_4 esterase locus on chromosome 3.

The E_4 esterase gene in maize has five alleles. Four of these alleles (E_4^C, E_4^D, E_4^E and E_4^F) are distinguishable by the relative rates of migration in electrophoresis of the enzyme types which they produce. The fifth (E_4^N) is a null or silent allele. A description of the banding patterns exhibited by the various alleles in electrophoresis is given in Maize News Letter 40: 53-56 (1966).

A series of translocations involving chromosome 9 was used to determine the location of the E_4 locus in the maize genome. These are shown in Table 1. Each of the translocation stocks was homozygous for the waxy gene (wx/wx) which is located approximately eleven crossover units from the centromere on the short arm of chromosome 9. Each of the translocation stocks was crossed with a stock which was normal with respect to chromosome constitution and which was homozygous for non-waxy (Wx/Wx). The stocks carrying translocations T_{1-9c}, T_{6-9b}, T_{7-9a} and T_{8-9d} were crossed with plants which were E_4^F/E_4^F. The stocks carrying translocations T_{3-9c}, T_{4-9g}, T_{5-9a} and T_{9-10b} were crossed with plants which were E_4^N/E_4^N. The stock carrying translocation T_{2-9b} was crossed with plants which were E_4^D/E_4^D. The offspring obtained from this series of crosses were then crossed with stocks which were again normal with respect to chromosome constitution but which were homozygous for waxy (wx/wx). Stocks carrying translocations T_{1-9c}, T_{2-9b}, T_{3-9c}, T_{4-9g}, T_{5-9a}, T_{6-9b}, T_{7-9a} and T_{8-9d} were crossed with plants which were E_4^F/E_4^F. The stock carrying translocation T_{9-10b} was crossed with plants which were E_4^D/E_4^D.

Kernels derived from the series of crosses between the translocation heterozygotes (which were also heterozygous Wx/wx) and the stocks which were normal in chromosome constitution (and also homozygous wx/wx) were then scored for waxy and non-waxy. These kernels were then germinated and root samples from seven day seedlings were run in electrophoresis in order to score for E_4 esterase constitution. The results are shown in Table 2. As can be seen from the data, there was found to be a close linkage between the E_4 locus and the Wx locus when chromosome 9 was involved in a translocation with chromosome 3. No appreciable linkage with Wx was observed when the translocation involved any of the other chromosomes in the maize genome. These results lead to the conclusion that the E_4 gene is located on chromosome 3 rather close to the breakage point (.09 on the long arm of chromosome 3).

Table 2

Results of testcrosses made to determine the location of the $\underline{E_4}$ gene in the maize genome

Cross	Results				
	D+F wx	F Wx	D+F Wx	F wx	Total
N/T_{1-9c} $\underline{Wx}/\underline{wx}$ $\underline{E_4}^F/\underline{E_4}^D$ x N/N $\underline{wx}/\underline{wx}$ $\underline{E_4}^F/\underline{E_4}^F$	127	133	142	142	544
N/T_{3-9c} $\underline{Wx}/\underline{wx}$ $\underline{E_4}^N/\underline{E_4}^D$ x N/N $\underline{wx}/\underline{wx}$ $\underline{E_4}^F/\underline{E_4}^F$	170	143	25	11	348
N/T_{5-9a} $\underline{Wx}/\underline{wx}$ $\underline{E_4}^N/\underline{E_4}^D$ x N/N $\underline{wx}/\underline{wx}$ $\underline{E_4}^F/\underline{E_4}^F$	6	11	7	10	34
N/T_{6-9b} $\underline{Wx}/\underline{wx}$ $\underline{E_4}^F/\underline{E_4}^D$ x N/N $\underline{wx}/\underline{wx}$ $\underline{E_4}^F/\underline{E_4}^F$	38	34	42	33	147
N/T_{7-9a} $\underline{Wx}/\underline{wx}$ $\underline{E_4}^F/\underline{E_4}^D$ x N/N $\underline{wx}/\underline{wx}$ $\underline{E_4}^F/\underline{E_4}^F$	57	54	47	49	207
N/T_{8-9d} $\underline{Wx}/\underline{wx}$ $\underline{E_4}^F/\underline{E_4}^D$ x N/N $\underline{wx}/\underline{wx}$ $\underline{E_4}^F/\underline{E_4}^F$	3	2	4	3	12
	E+F wx	D+F Wx	E+F Wx	D+F wx	Total
N/T_{2-9b} $\underline{Wx}/\underline{wx}$ $\underline{E_4}^D/\underline{E_4}^E$ x N/N $\underline{wx}/\underline{wx}$ $\underline{E_4}^F/\underline{E_4}^F$	58	85	65	68	276
	E+F wx	F Wx	E+F Wx	F wx	Total
N/T_{4-9g} $\underline{Wx}/\underline{wx}$ $\underline{E_4}^N/\underline{E_4}^E$ x N/N $\underline{wx}/\underline{wx}$ $\underline{E_4}^F/\underline{E_4}^F$	29	47	34	50	160
	D+F wx	D Wx	D+F Wx	D wx	Total
N/T_{9-10b} $\underline{Wx}/\underline{wx}$ $\underline{E_4}^N/\underline{E_4}^F$ x N/N $\underline{wx}/\underline{wx}$ $\underline{E_4}^D/\underline{E_4}^D$	7	11	7	7	32

Table 1
Translocation stocks used in crosses designed to determine the location of the $\underline{E}_4$ gene in the maize genome

Translocation	Breakage Points	$\underline{E}_4$ Esterase Genotype
$T_{1\text{-}9c}$	(1S.48; 9L.22)	$\underline{E}_4^D/\underline{E}_4^D$
$T_{2\text{-}9b}$	(2S.18; 9L.22)	$\underline{E}_4^E/\underline{E}_4^E$
$T_{3\text{-}9c}$	(3L.09; 9L.12)	$\underline{E}_4^D/\underline{E}_4^D$
$T_{4\text{-}9g}$	(4S.27; 9L.27)	$\underline{E}_4^E/\underline{E}_4^E$
$T_{5\text{-}9a}$	(5L.69; 9S.17)	$\underline{E}_4^D/\underline{E}_4^D$
$T_{6\text{-}9b}$	(6L.10; 9S.37)	$\underline{E}_4^D/\underline{E}_4^D$
$T_{7\text{-}9a}$	(7L.63; 9S.07)	$\underline{E}_4^D/\underline{E}_4^D$
$T_{8\text{-}9d}$	(8L.09; 9S.16)	$\underline{E}_4^D/\underline{E}_4^D$
$T_{9\text{-}10b}$	(9S.13; 10S.40)	$\underline{E}_4^F/\underline{E}_4^F$

John W. Harris

6. Association of crossing over and production of unstable $\underline{a}^p$ alleles.

The $\underline{a}^p$-D35 allele arose in two steps from an $\underline{a}_1$ exposed to Dt: $\underline{a}_1$ $\xrightarrow{Dt}$ A:D2 $\xrightarrow{Dt}$ $\underline{a}^p$-D35 (Neuffer). In the absence of Dt, the $\underline{a}^p$-D35 allele gives a uniformly faint aleurone color; if Dt is present, dots of deep color are formed, as well as sectors of intermediate color, on a pale background. A stock of $\underline{a}^p$-D35 without Dt was obtained from Neuffer and crossed with a $T2\text{-}3\text{-}\underline{a}_1\text{-}\underline{sh}_2$ stock also without Dt, obtained from Laughnan. F_1 plants of $\frac{N\ a^p\text{-}D35\ Sh}{T\ a\ \ \ sh}$ dt dt constitution were testcrossed by N-a-sh dt male parents and the 34 resulting ears were scanned for colored shrunken crossovers. One ear produced two sh kernels that were pale colored. With the exception of one A sh kernel, a possible contaminant, these were the only colored shrunken crossovers detected on the 34 testcrossed ears. Some of the pale sh kernels are probably overlooked because of similarity to colorless sh. The two pale sh kernels mentioned above had fairly deep aleurone color. Both individuals proved to be heterozygous for the translocation; i.e. they arose by a double crossover in the F_1. Self pollinations of the two plants gave ears segregating pale and colorless seeds, all of which were shrunken. Many of the pale seeds had one or two very small dots of color; these are apparent on sh seeds only after careful scrutiny, usually with a dissecting microscope. The original two kernels were not closely examined for dots, but the pale Sh kernels on the