5. Effects of alleles at the *Tu-tu* locus.

The most conspicuous effect of the Tu gene is to accentuate – on some genetic backgrounds to exaggerate – the development of both the staminate and pistillate glumes. Not so readily apparent is the fact that this gene frequently causes the rachis to be more slender. This suggests that there is competition between the glumes and the rachis for the energy available for the development of the ear. Since the rachis represents the "system of supply" to the kernels, it is possible that reducing the glumes and increasing the rachis may also lead to an increase in total grain production.

Since we now have available a series of alleles at the Tu-tu locus it is possible to study the effect of different alleles upon the glume/rachis ratio. In order to make such a study we are developing, by repeated backcrossing to the inbred A158, isogenic stocks for comparing the different alleles on a uniform genetic background. Several additional years will be required to complete the study but the preliminary results already available from stocks not yet completely isogenic have proved to be interesting and significant.

The glumes were separated from the rachis and both were weighed. The lemmas and paleas which are enclosed in the glumes were weighed with the glumes. The results are shown in Table 5.

Table 5. Effects of alleles at Tu-tu locus on the relative development of glumes and rachis of the ears.

		Weight in Gms.			
Genotype	No. Ears	Total	Glumes	Rachis	Ratio Gl./Rach.
Tu tu	2	17.62	14.34	3.28	4.38
tu^h tu^f	3	23.99	17.21	6.78	2.54
tu^h tu	6	21.76	13.24	8.52	1.56
tu^f tu	3	22.48	11.86	10.62	1.12
tu tu	5	20.93	9.94	10.49	.95

The data show that the total weight of the cob (glumes, lemmas, paleas and rachis) does not vary greatly with different genotypes, but the glume/rachis ratio varies decidedly and consistently from 4.38 in the genotype Tu tu to 0.95 in the genotype tu tu.

The effect of the alleles upon potential grain production is not so easily measured, at least in these ears all of which were hand-pollinated and not completely filled. Potential grain production was estimated by multiplying the average number of rows x average number of kernels per row x average weight of kernels from a well-filled portion of the ear. The results, although not consistent in all respects, since these ears are not from completely isogenic stocks, are still significant (Table 6). Accompanying an increase in the size of the rachis are slight increases in kernel-row number, number of kernels per row, total number of kernels and perhaps in average weight of kernels. All of these factors combine to produce a substantial and

fairly consistent increase in total potential grain production. In these preliminary tests genotype tu tu is slightly lower in potential grain production than the genotype tu^f tu, but the difference is probably not significant and can be attributed to a single atypical ear with unusually small kernels included in the study.

Table 6. Effects of alleles at the Tu-tu locus on potential grain production.

		Potential Kernels		Kernel Weight	
Genotype	No. Rows	Per Row	Total	Average	Total
Tu tu	13.0	22.5	293	.242	70.9
tu^h tu^f	15.3	27.0	413	.187	77.2
tu^h tu	14.0	32.8	459	.224	102.8
tu^f tu	140.0	34.7	486	.233	113.2
tu tu	14.0	33.2	465	.227	105.5

The data in Tables 5 and 6 indicate that the evolution of the ear of maize may be, in large part, the product of changes in glume-rachis relationships with these, in turn, affecting grain production. It is not yet certain that wild corn was of the genotype Tu Tu (for the gene Tu may prove to be a pseudo-allele which arose under domestication) but it must certainly have been some form of a pod corn. The earliest cultivated corn found in archaeological sites has glumes and rachises similar to those characteristic of tu^f and tu^h. Mutations at the Tu-tu locus have created considerable variation in the glume/rachis ratio involving a secondary but highly important effect upon grain production. Both human selection and natural selection operating in a man-made environment would tend to favor the lower alleles and to work toward the extinction of the higher ones. Evolution of the ear of maize seems, therefore, to be, in substantial part, the product of evolution at one gene locus – the Tu-tu locus on chromogome 4.

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