(B) Barren culms: A very high proportion of barren culms has been observed in Nt populations. The frequency of occurrence ranges between twenty to fifty percent and is equally distributed among notched and notchless derivatives of original Nt. In isolated self families the frequency of barren stalks is as high as eighty percent. Over the years the barren population in self families has increased many fold. A tendency of "more notching - less female fertility" is seen. In cross section the stalk looks circular and the characteristic concave groove is absent.

(C) Dwarf culms: All inbred lines derived from original Nt, either by continuous selfing or sibbing, have produced plants one half to one fourth the normal height. This dwarfism is accompanied by a thickening of the lower stem, a reduction in the internodal distance (the number of nodes remaining the same), a lower placement of the ear (in some cases right at the soil level) and a hardening of the entire culm. Leaves become very dark in colour, shorter, very wide, stiff and wrinkled in most families. Hybrids with Nt parents, however, are normal and sometimes taller than either parents.

(D) Anthocyanin pigmentation: From the start it has been observed that derivative lines from parental Nt stocks produce deep purple coloured stalks, leaf sheaths, ear husk and leaf margins. The pigmentation becomes deeper toward maturity. In a 1970 summer hybrid family (F_1 normal ♀ backcrossed to Nt ♂) purple pigmentation was so widespread and intense that the entire plant was purple at maturity. Calculations indicate that about seventy-five percent of the total plant surface area is purple in this family. In notchless derivatives the pigmentation is normal.

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3. Inheritance of "Notched leaf of corn": Some considerations.

Originally starting from two 1967 Nt plants, some 200 self and 75 hybrid lines have been developed and field investigated. The segregation pattern available from these studies does not permit a definite theorisation. In Table 1, the behaviour of self families derived from one of the original Nt plants is shown. Table 2 gives the hybrid behaviour of the same.

Table 1

Segregation of self progenies for the Nt factor

1967 (S1)	1968 (S2)	1969 (S3)	1970 (S4)
2 Nt : 240 Normal	17 Nt : 49 Normal	52 Nt : 17 Normal	30 Nt : 31 Normal
		105 Nt : 36 Normal	15 Nt : 10 Normal
		51 Nt : 31 Normal	31 Nt : 8 Normal
		27 Nt : 6 Normal	54 Nt : 19 Normal
			85 Nt : 1 Normal
			46 Nt : 26 Normal

At the present level of investigations two possibilities can be considered to explain the nature of Nt: first, a gene based mechanism and second, a chromosomal aberration theory.

If a gene based mechanism is considered, then it is apparent that the gene or genes involved have a very weak phenotypic stability. With advancing generations, however, the expression of Nt is becoming stronger (as is evidenced by comparative visual studies of Nt in the last three years). The poor and incomplete penetrance may also be due to a complex manipulation of the character by a major gene and some modifiers so that phenotypic manifestation of the Nt depends on the modifying actions of the latter.

An alternative possibility is that a chromosomal aberration (probably a deletion) is responsible for Nt. Bridges (1917) and Mohr (1917) investigated a similar deletion in Drosophila melanogaster. Also called "Notch," the mutant produced a notched margin of the wings. In the female, the mutant was inherited as a sex linked dominant while in the male it was lethal. A number of recessive genes in the deleted chromosome were also observed to show pseudo dominance. In the "Notched leaf of corn" a parallel condition can be observed. A survey of Table 1 indicates that in many families Nt behaves like a dominant factor. Off ratios, however, are very frequently recorded. Table 1 includes such ratios. It is possible that pollen sterility and barren culm factors contribute toward this ratio disturbance. In 1970 summer,

Table 2

Behaviour of Nt in hybrids

Cross	F_1 Segregation	⊗ Class or Cross	F_2 Segregation	⊗ Class or Cross	F_3 Segregation
BM 178 x Nt	1 Nt : 239 Normal	Nt	15 Nt : 79 Normal	Nt Normal	15 Nt : 49 Normal 0 Nt : 52 Normal
				Normal Nt	3 Nt : 22 Normal
		Normal	6 Nt : 172 Normal	Normal	0 Nt : 53 Normal
Nt x BM 408	0 Nt : 121 Normal	Normal	0 Nt : 51 Normal		
Nt x BM 404	0 Nt : 320 Normal	Normal	0 Nt : 107 Normal		
BM 408 x Nt	7 Nt : 626 Normal	Nt - 1	17 Nt : 72 Normal		
		Nt - 2	27 Nt : 143 Normal		
		Nt - 3	10 Nt : 94 Normal		
		Normal bc Nt	13 Nt : 64 Normal		
BM 404 x Nt	6 Nt : 226 Normal	Nt - 1	10 Nt : 74 Normal		
		Nt - 2	5 Nt : 103 Normal		
		Normal - 1	0 Nt : 86 Normal		
		Normal - 2	0 Nt : 74 Normal		

BM 170, BM 404 and BM 408 are inbred lines of the Institute.

one family with a homozygous genotype for Nt has been isolated.

The behaviour of Nt in hybrids gives another indication of chromosomal deletion. A survey of Table 2 shows that a very low frequency of character transmission to F_1 progenies is shown by Nt. Further, Nt appears in F_1's only when transmitted through the pollen. Differential transmission of the deletion in the male and female gametophytes may be the cause of the disturbance in the observed phenotypic ratios.

The very low frequency of Nt in open populations and hybrids and its stabilization pattern in some continuous self families compare well with several studies on chromosomal aberrations. Norman Giles (1940) showed that in Tradescantia spontaneous chromosome aberrations are produced in very low frequencies and are caused by very low natural radiation doses. Sax (1940, 1938) also states that the frequency of spontaneous or induced deletions shows an approximately linear relation with radiation doses and hence they have varying levels of stability and perpetuation.

In 1967 summer only two plants in a population of 240 produced Nt. Seed for this population came from a five year old stock stored in natural conditions of temperature and humidity. It has been demonstrated by some workers (Peto, 1933 and Navashin, 1933) that seedlings grown from aged seed show a pronounced increase in the frequency of spontaneous chromosome structural changes. Physiological conditions attendant on aging may be responsible for the increase in such structural changes. Storage factors coupled with natural sources of stress (radiations, etc.) might have been responsible for Nt.

Studies with the character association of Nt suggest that a segment of the third chromosome may be involved. This, however, is a tentative proposition and needs further strengthening.

References

Giles, Norman. 1940 Spontaneous chromosome aberrations in Tradescantia. Genetics 25:69-87.

Sax, K. 1940 An analysis of X-ray induced chromosomal aberrations in Tradescantia. Genetics 25:41-68.

Sax, K. 1938 Chromosome aberrations induced by X-rays. Genetics 23: 494-516.

Navashin, M. 1933 Origin of spontaneous mutations. Nature 131:436-438.

Peto, F. N. 1933 The effect of aging and heat on the chromosomal mutation rates in maize and barley. Can. J. Research 9:261-264.

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4. Does "Notch" represent an altered biochemical sequence?

While conducting some anatomical studies with Nt leaves, a few leaf portions were inadvertently put in a jar containing strongly acetified solution of ferric acetate in absolute alcohol. Within a fortnight's time while green, chlorophyll containing parts of the leaf turned colourless, the notched area and streaks emanating from it turned brown-black.

This indicates a chemical reaction in the Nt area. Several possibilities exist to explain this phenomenon. The absence of chlorophyll from the notched area indicates the presence of either an altered form of the pigment or some other chemical not to be found in other tissues of the leaf. This altered pigment or chemical could be reacting with ferric or acetate ions in the solution. The altered chemical may be a carbohydrate or a protein.

If a gene based mechanism is accepted, then the reaction will have to be viewed either as a primary or a secondary product of the gene action. Further studies are necessary before a final theory is accepted.

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1. Further studies on the synaptonemal complex of haploid maize.

Microsporocyte divisions of haploid maize were studied with electron microscopy. From zygonema to early pachynema, the central element of synaptonemal complexes was not present, while the two lateral elements were consistently observed. At middle pachynema, all of the