

Heterosis and the night-length reaction: effect of the night-length reaction on the plant height of the tallest strains of the maize subspecies

--Karl, JR

Heterosis is known to be negative for the trait of short-night reaction in maize. This may mean that an F1 will be shorter than the parents in relation to the degree of heterosis when crossing extremely reactive strains; the height difference is due to a change in leaf quantity. This height heterosis evidently does not have a substantial effect in crosses with or within the Tehua race, though inbreeding Tehua may significantly reduce plant height (by perhaps 4.5 meters [m]). The heterosis is, however, evident within the Montaña race.

Two tall strains of Tehua (Chiapas 234 and NSL 2825, under short night) were crossed and the F1 had the same relative height and quantity of leaves (roughly 48). When crossed with a shorter strain, the F1 was shorter (~10.5 m, mature height). This possible absence of heterosis also occurs when the Tehua is crossed with other tallest strains. For example, a cross was made of the populations Chiapas 234 with Ecuador 689, which is of the Montana race. A plant from the cross was permitted to attain the height of 8 m and at that height the whorl exhibited no indication of tasseling, similar to the parent strains. (Indication of tasseling entails the whorl irregularities of being tightly funneled, with upright leaves, irregular leaf spacing, creases, and forked tips, as well as nodal protrusion from leaf sheaths.) A shorter Montana likewise makes a shorter F1 (~10.5 m). 234 crosses (with other tallest strains e.g., Veracruz 406, from the race Coscomatepec) grow 5.25 m on uncultivated grassy ground in Costa Rica under natural night length (where 234 is still reactive). Two tall strains of Montana (Ecuador 573, 689) were crossed. The F1 matured at an 8-m plant height, whereas the F2 exhibited no indication of flowering at 7.7 m. The F2 thus matures at a height similar to that of the parent populations (~10.7-12 m).

As maize plant height comprises not only tassel size and internode quantity, but also internode length, aside from the effect of night length in these maizes, it is interesting to note that the peak internode length on some hybrids with or within the Montana race is 44.5 cm (Figure 1)(cf. 3 consecutive internodes of >43.3 cm with the Jala race), and is 38.5 cm for the Tehua 234 (Figure 2), which is ostensibly not party to such heterosis (perchance 2825 is 234) (Figures 3, 4). It seems that Montana offers many tallest strains of maize; however, it has particularly long internodes, even in the field (.36 m); Tehua seems to be the opposite. Heterosis increases the appearance of ears in these extremely short-night-reactive backgrounds, as is usual for the subspecies in general. This is also a case study in salvaging repository accessions (with genetic diversity inadequate for a population) by hybridizing 2 of them.

INTERNODE-LENGTH OF MAIZE HYBRID
Between Two Accessions of the Montana Race. Ecuador 573 X 689.

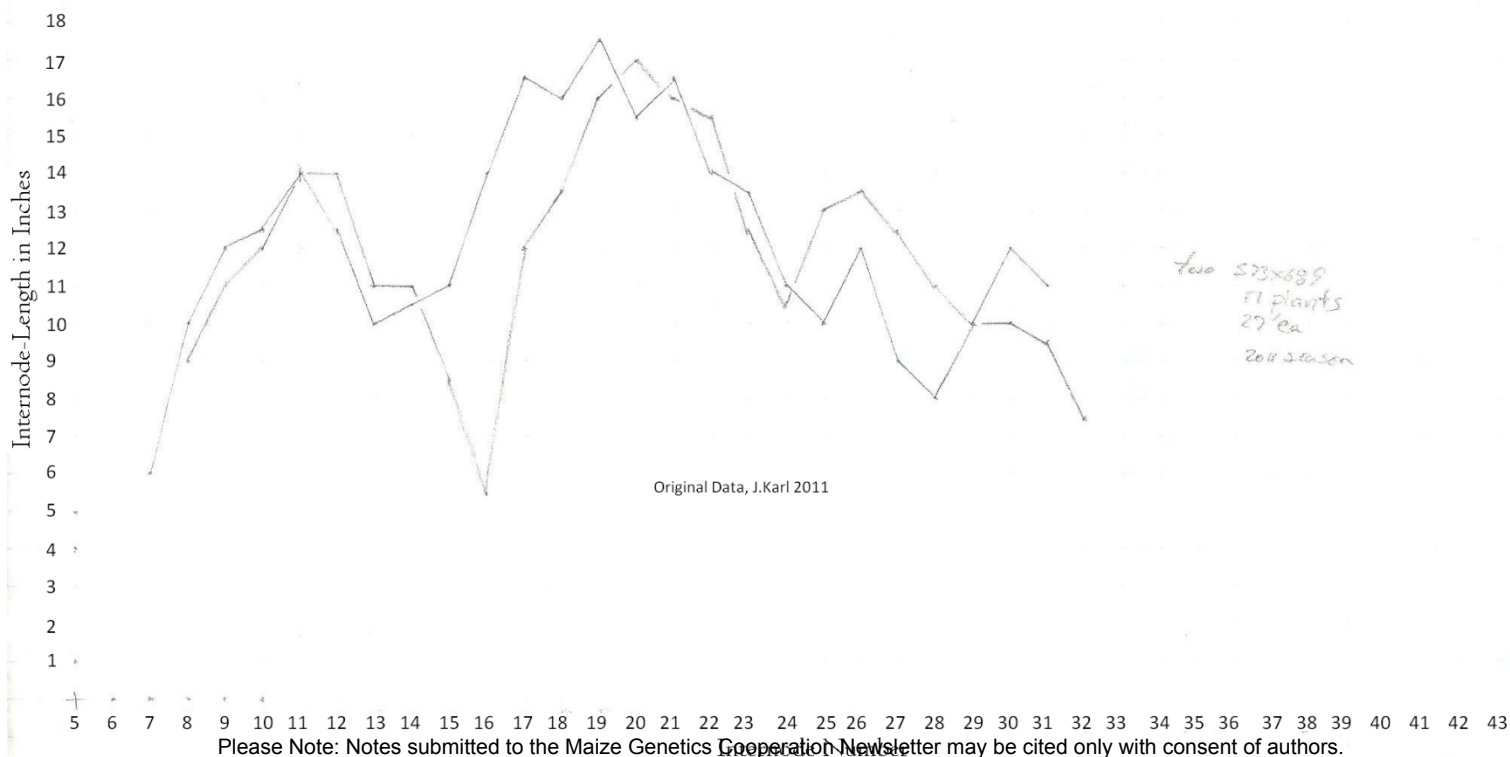


Figure 1. Trend of internode-length profile of tall strains of Montana.

Two Strains of the Tehua Race. Chiapas 234 vs. 234 X NSL 2825 F1.

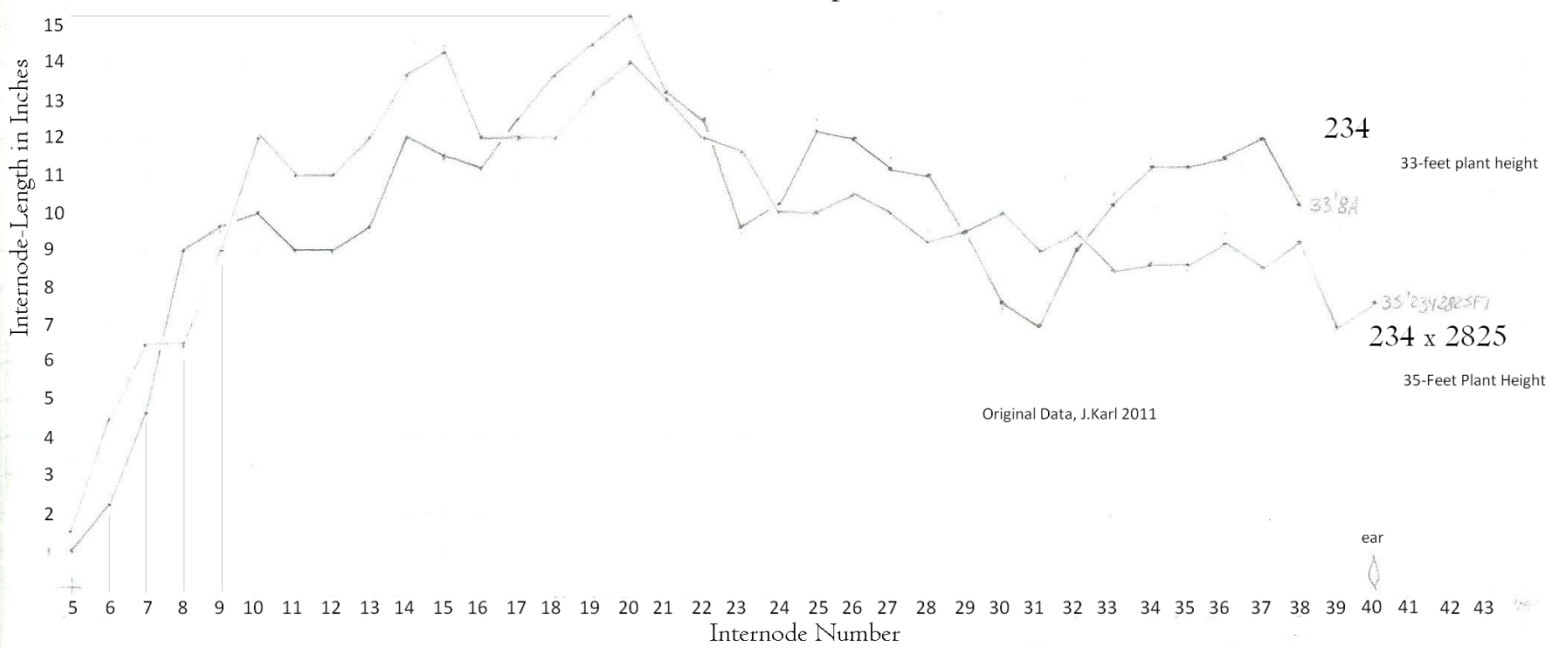


Figure 2. Trend of internode-length arcade of tall strains of Tehua.

INTERNODE-LENGTH OF MAIZE
Two Races Compared. Tehua & Montana.

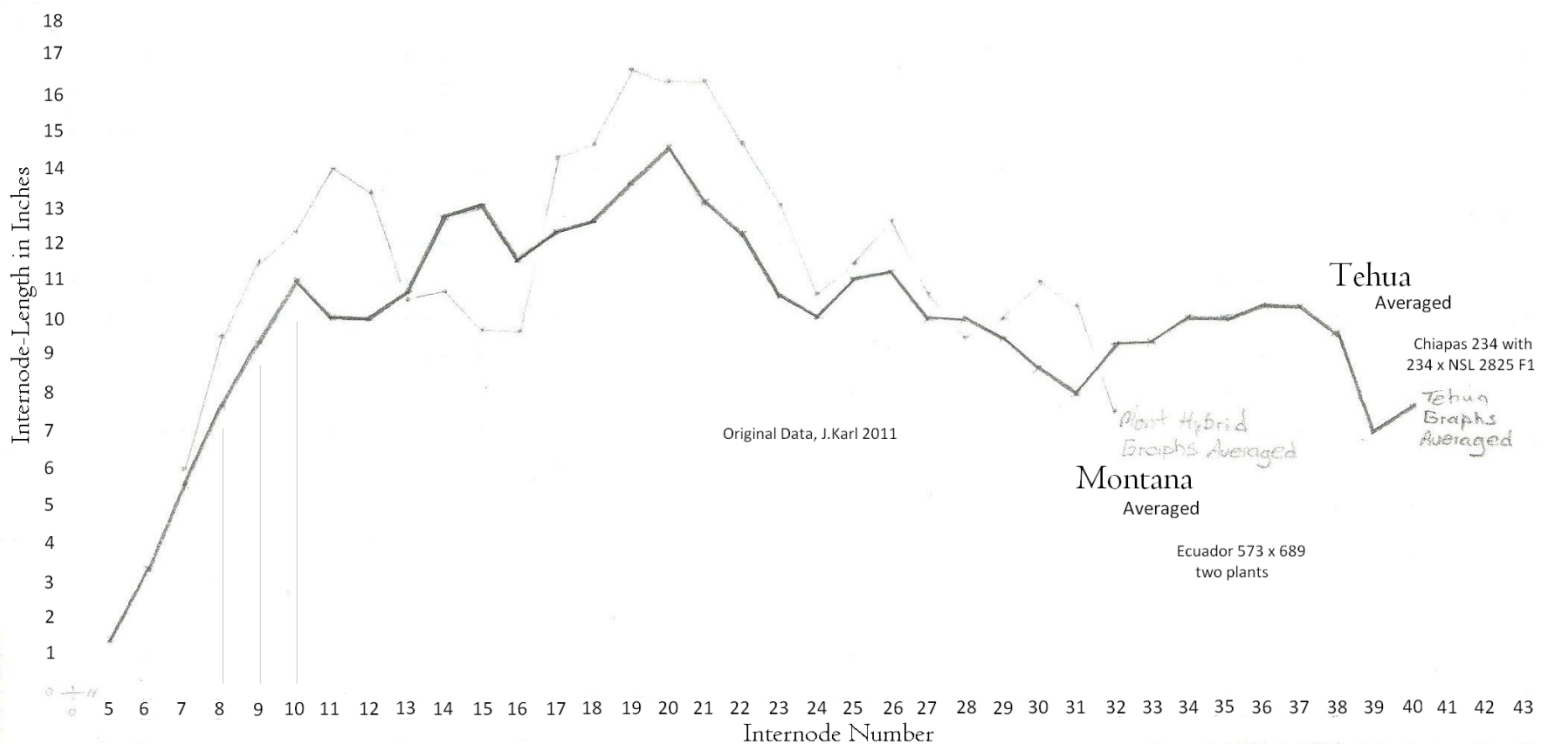


Figure 3. Compared trends of internode-length arcade of tall strains of Tehua and Montana.

Maize Internode-Length
 Maize Genetics Cooperation Newsletter vol 86 2012
 Race Tehua & Montaña

Two Montana Accessions Crossed, Ecuador 573 x 689.

Tehua Chiapas 234, and Tehua 234 x NSL 2825 F1.

Original Data, J.Karl 2011.

Internode	Number	Montaña FI	(Plant 1)	Montaña FI	(Plant 2)	Tehua FI	Tehua 234		
1									
2									
3									
4									
5						1.5	1		
6						4.5	2.2		
7	6					6.5	4.7		
8	10	9				6.5	9		
9	12	11				9	9.7		
10	12.5	12				12	10		
11	14	14				11	9		
12	12.5	14				11	9		
13	10	11				12	9.7		
14	10.5	11				13.7	12		
15	11	8.5				14.3	11.5		
16						14	5.5	12	11.2
17						16.5	12	12	12.5
18						16	13.5	12	13.7
19						17.5	16	13.2	14.5
20						15.5	17	14	15.2
21						16.5	16	13	13.2
22						14	15.5	12	12.5
23						13.5	12.5	11.7	9.7
24						11	10.5	10	10.2
25						10	13	10	12.2
26						12	13.5	10.5	12
27						9	12.5	10	11.2
28						8	11	9.2	11
29						10	10	9.5	9.5
30						12	10	10	7.7
31						11	9.5	9	7
32							7.5	9.5	9
33								8.6	10.2
34								8.7	11.2
35								8.7	11.2
36								9.2	11.5
37								8.6	12
38								9.2	10.2
39								7	
40								7.7	

Figure 4. Internode-length data for stalks from tall strains of Tehua and Montana.