

INTERNODE LENGTH IN PISUM: EFFECT OF THE GENE art (arthritic)

Rothwell, R. N. and I. C. Murfet

Botany Dept., University of Tasmania
Hobart 7001, Australia

The gene art (arthritic) is characterized by the presence of swollen nodes, undulate leaves and stipules, and a marked fore-shortening of the upper internodes (2). The latter effect is clearly shown by the results in Table 1 obtained from two near-isogenic tall (Le/Le) F5 progenies [B584-705-(2) and (4)] which were segregating for the Art-art pair of alleles. A significant reduction in the internode length of art segregates was already apparent in the lower internodes, e.g. internode 5 was 26% shorter in art than Art segregates. (Internode 5 is defined here as lying between nodes 5 and 6 counting from the lowest scale leaf as node 1). As noted by Marx (2) the reduction was even greater in the upper portion of the stem, and for the internode two below the first flower (internode 17 or 18 in this case) the art segregates were 40% shorter than their Art counterparts. There was a distinct difference in final height between the two genotypes (Fig. 1) with art segregates attaining an average only two-thirds the final height of Art segregates. The two genotypes flowered at the same node (both means 19.4) and they produced an almost identical number of internodes (art 22.4 and Art 22.1). Hence in this case the difference in final height truly reflects the cumulative effect of the difference in internode length.

We examined the anatomical basis for the difference in internode length between Art and art plants using the epidermal strip technique (1). Length measurements were made for 10 epidermal cells and 30 outer cortical cells per internode per plant. Cortical cells were measured in sets of three. Cell numbers per internode were estimated by dividing the length of an internode by the mean cell length for that internode.

A similar anatomical pattern emerged regardless of the internode or cell type considered (Table 1). It is clear that the reduction in internode length in art, segregates was wholly attributable to a marked reduction in the number of cells per internode. Cell length was in fact slightly greater in art segregates than Art segregates but the difference did not attain statistical significance in the present study. However, the consistency of the effect across cell type and internode position suggests that it may have proved significant if a larger sample size had been used. The results for art contrast with those obtained for the internode length mutants le and na (3) and lk (4) where the reduction in internode length was found to be associated in each case with a marked decrease in both cell number and cell length.

Acknowledgement. We are indebted to Prof. G. A. Marx, NYS Agricultural Experiment Station, Geneva, NY, for providing seed of the progenies used and for drawing our attention to the effect of art on internode length.

1. Arney, S. E. and P. Mancinelli. 1966. *New Phytologist* 65:161-175.
2. Marx, G. A. 1981. *PNL* 13:38-39.
3. Reid, J. B., I. C. Murfet. and W. C. Potts. 1983. *J. Exp. Bot.* 34:349-364.
4. Ross, J. J. and J. B. Reid. 1986. *Physiologia Plantarum* 67:673-679.

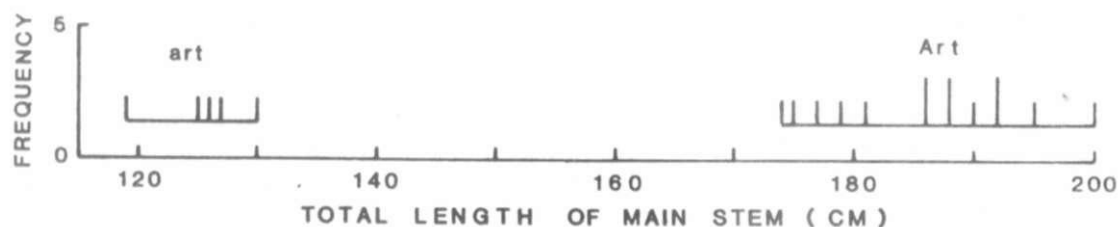


Fig. 1. Distribution of final height for art/art and Art/- segregates in F₅ progenies B584-705-(2) and (4). All plants were tall (Le/Le).

Table 1. Effect of the Art-art gene difference on internode length and on the length and number of epidermal and outer cortical cells.

Genotype	Internode	Stem length (mm)		Epidermal cells				Cortical cells			
		Mean	S.E.	Length (µm)		Number		Length(mkm)		Number	
				Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.
Art/-	5	65.8	0.9	384	18	173	6	125	3	528	17
art/art	5	48.4***	2.8	424	29	116**	9	134	13	368***	25
Art/-	17 or 18 [§]	132.4	12.5	304	19	439	45	91	7	1459	126
art/art	17 or 18 [§]	78.8**	3.6	324	17	247**	23	106	1	745***	25

** *** - Difference between the Art/- and art/art means significant at the 0.01 or 0.001 level, respectively.

§ - The internode two below the first flower. (Flowering commenced at node 19 or 20.)

The data were obtained from 5 Art/- and 5 art/art segregates in two near-isogenic tall (Le F5 progenies. Plants were grown one per 14 cm slimline pot under an 18 h photoperiod.