

Tendrils Morphology in Bush and Vine Genotypes of Squash and Pumpkin

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Introduction

Tendrils are threadlike, coiling organs differentiated from specialized lateral shoots initiated at leaf axils, and which function in mechanical support of plants with a vining habit of growth. Morphologically, they are commonly comprised of a basal stem or shoot axis of variable length which branches into tendrils which are thigmotropic, coiling around objects in which they come in contact. They are a ubiquitous organ within the Cucurbitaceae family (5, 7), but do not appear to confer any substantial advantage to domesticated cucurbits mostly grown in row cultural systems employed in modern agricultural practice.

In the genus *Cucurbita*, many of the new modern cultivars have a bush or semi-bush habit of growth, and it was stated in the classical book on Cucurbits by Whitaker and Davis (9) that bush squashes “differ from the common trailing varieties by their much-shortened internodes and lack of tendrils.” At the time the “Cucurbits” book was published in 1962, most bush varieties of squash were types grown for consumptions of immature squash, and characterized by extremely shortened internodes, a phenotype likely conferred by several genes, and not the single incompletely dominant *Bu* gene described by Shifriss in 1947 (8).

In the current breeding germplasm of ornamental pumpkin and winter squash at the University of New Hampshire, both bush and vine forms are represented among the three major economic species, *C. pepo* L., *C. moschata* Duch., and *C. maxima* Duch., and we have found that presence of tendrils is the rule and not the exception in bush plants. This report summarizes the relationship of the basal shoot or stem length in tendrils to internode length in several breeding lines representing bush and vine genotypes among the three economically important species of squash and pumpkin.

Materials and Methods

Plants were seeded into 50-cell plug trays during the first week of January, 2013, and transplanted into 8.7 L

plastic nursery pots in a soil-less mix (Pro-mix, Griffin Greenhouse Supply, Tewksbury, MA, US) during the first week of February. Temperatures were maintained at 24 °C day and 18 °C night, and plants grown under natural daylight. Data on mature internode and tendril length were recorded on 01 April, 2013, using bush and vine breeding accessions.

Results and Discussion

As described for *Echinocystis lobata* (5), the axillary bud complex differentiates on one side of a node with tendrils differentiated at the most basal portion of a node, the flower bud(s) at the most distal portion, and the axillary shoot, when present, initiated between the tendril and flower organ (Fig 1). Tendril morphology of the examined breeding lines is shown in Fig. 2 and 3, and quantitative data on internode length and length of the basal shoot of tendrils is given in Table 1, along with branching characteristics of the tendrils. Breeding lines were chosen so as to represent the wide variation in internode length that exists in both bush and vine cultivars of *Cucurbita* (6). Length of tendril shoots was positively correlated with mean internode length among breeding lines of all three species (Table 1). However, occasionally a bush accession with moderately long internodes, had an extremely short tendril shoot, as exemplified by NH29-1-27 (Table 1). Genetic dwarfism in *C. pepo* (4) and *C. maxima* (3) is reversed by application of gibberellins and so any deficiency of this hormone or a deficiency in perception of this hormone in a plant would be expected to elicit a similar response in both internodes and tendril shoots. There also appeared to be a general tendency for reduced branching and elongation of tendrils in bush plants (Fig. 2 & 3), and in bush plants of NH199-30-5-2 (*C. moschata*), tendrils were not present at all nodes. A similar deficiency of tendrils was observed in bush breeding lines of egg gourds (*C. pepo*) and the basal shoot of tendrils was often barely visible (Fig. 2E). Therefore, gibberellins may be involved in both elongation and differentiation of tendril shoots. The results of Ameha et al. (2) lend some support to this postulate. They grew

plants from seeds and cotyledon segments of cucumber *in vitro* with different growth regulator treatments. In cultures supplemented with GA₄₊₇, shoots were highly elongated and developed tendrils but not flower buds; whereas, cultures supplemented with either BA or GA₃, developed flower buds but not tendrils at leaf nodes. Contrary to the results of Ameha et al. (2), it is normal for nodes of *Cucurbita* plants to differentiate both flowers and tendrils.

There were no vine genotypes of *C. maxima* grown in the greenhouse in winter-spring of 2013, but one breeding line segregated for extreme bush plants, permitting a comparison of tendril length in two bush genotypes having significantly different internode lengths. Internodes of NH31-7-134 were more than double the length of those of NH46-4-11-2164-5, and the basal tendril shoot of NH31-7-134 was three times longer than that of NH46-4-11-2164-5 (Table 1; Fig. 3D, E). However, both bush *C. maxima* lines averaged 5 tendril branches, a number not out of line with branching reported in vine cultigens (1).

Acknowledgements

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Table 1. Variation in tendril morphology among bush and vine forms of squash and pumpkin among the three major economic species of *Cucurbita*.^z

Species and accession	Genotype	Internode length	Tendril stem length	Tendril branching
<i>Cucurbita pepo</i>				
NH123-12-428	bush	3.2±0.8	1.0±0.3	2 + 1 ^y
NH29-1-27	bush	7.9±1.9	1.1±0.2	2 - 3
NH24-6-1	bush	10.9±1.5	6.3±1.0	4 (5) ^x
NH.H02-113	vine	18.1±1.2	17.3±4.1	4
<i>Cucurbita moschata</i>				
WBN1-4-10	vine	16.4±1.3	13.2±1.3	3
NH204-3-9-16-1	vine	9.6±1.1	6.7±0.6	3
NH199-30-5-2	bush	7.1±1.8	2.2±0.5	2
<i>Cucurbita maxima</i>				
K31-7-134	bush	11.0±1.4	5.0±1.0	5
K46-4-11-2164-5 ^w	bush	4.9±1.2	1.7±0.1	5 (6)

^zData are means ± SD of 8 mature internodes (4 per plant) and 8 tendrils which subtended the distal node of each internode. Data were taken with calipers to hundredths of a cm and rounded to tenths.

^yTwo tendril branches + occasionally a compound tendril which branched into two tendrils.

^xOccasionally 5 tendril branches.

^wExtreme bush segregant; mean values of 5 internodes and tendrils; occasionally 6 tendril branches.



Figure 1. Node on a bush plant of *C. pepo* showing positions of tendril, axillary shoot and flower bud.

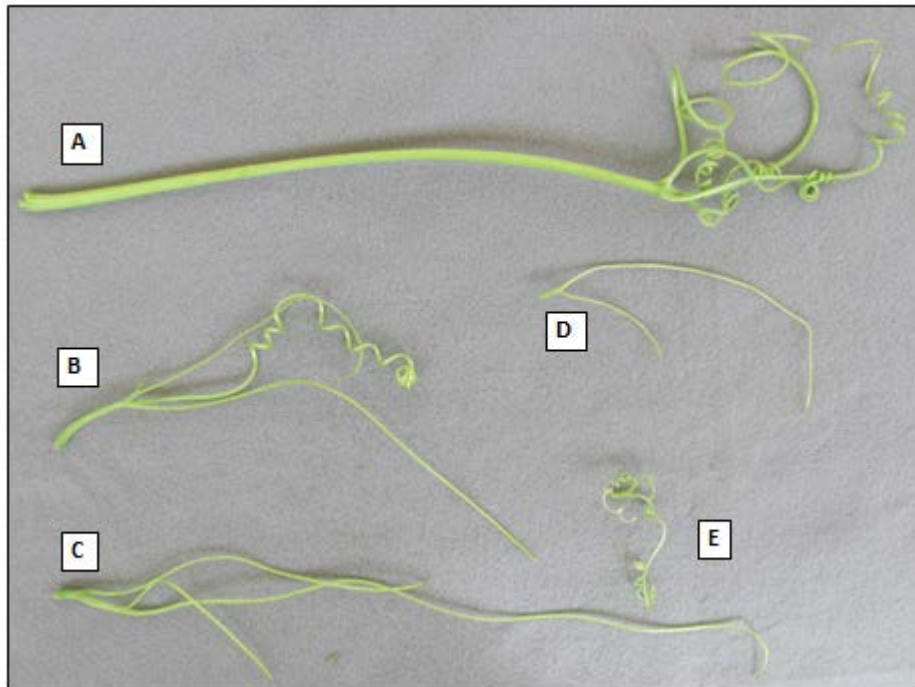


Figure 2. Tendril morphology in *C. pepo*: NH.HO2-113V (A), NH24-6-1V (B), NH29-1-27Bu (C), NH123-12-4-2-8Bu (D), and bush egg gourd (E).

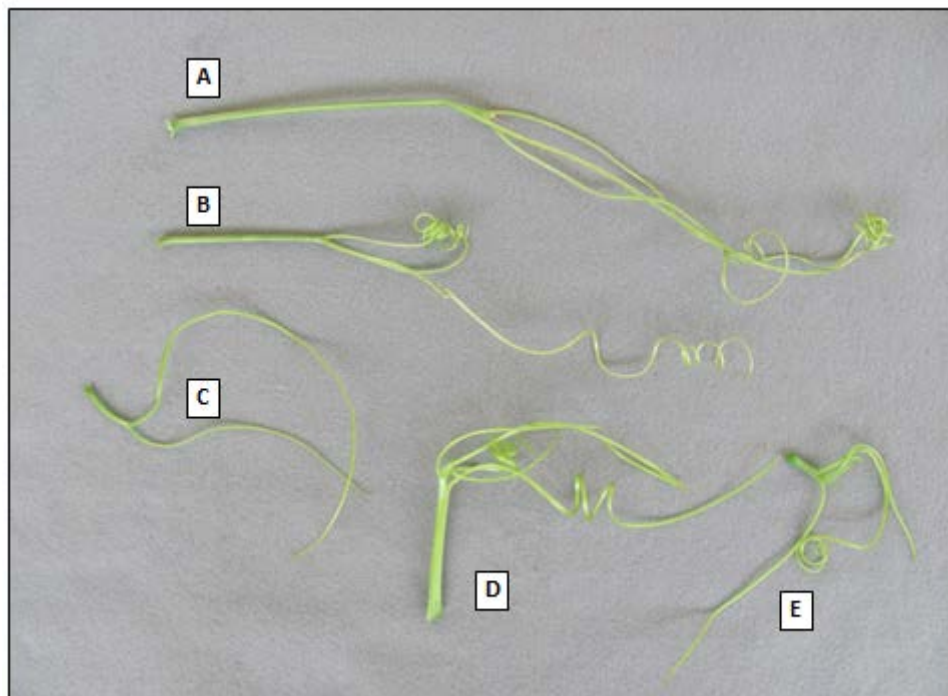


Figure 3. Tendril morphology in *C. moschata*: A = WBN1-4-10V; B = NH204-3-9-16-1V; C = NH199-30-5-2Bu; and *C. maxima*: (D = NH31-7-1-3-4Bu; E = NH46-4-11-2164-5Bu).