# Effects of Node Position on Lateral Bud Outgrowth in the Decapitated Shoot of *Ipomoea nil*[1]

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**Abstract. The effects of node position and initial bud size on lateral bud outgrowth were studied following the release of apical dominance by decapitation of the main shoot of *Ipomoea nil* just above each of the first six nodes. Position effects were found. The greatest outgrowth occurred during a four-day period in the buds at the middle and higher nodes, with the least growth occurring in the bud at the lowest and oldest node. Variation in leaf number had no effect. Although initial bud size appears to have some influence over the outgrowth of lateral buds following decapitation, age and the associated factor of inhibitor content probably play a more significant role.**

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## INTRODUCTION

According to Phillips (1975), "All vegetative buds on a plant possess essentially equal developmental potential." However, Zieslin et al. (1976) determined that rose buds lower on a shoot were more inhibited than higher ones. Theron et al. (1987) reported a correlation in apple between inhibition in buds and age. Cutter and Chiu (1975) found that different lateral buds along the stem of *Hygrophila* responded in various ways to different factors which release apical dominance. Gould et al. ( 1987) concluded that growth differences exist in both isolated and intact buds along a stem.

For a number of years we have investigated various aspects of apical dominance in Japanese Morning Glory (*Ipomoea nil*) (Cline 1983, 1991). The question has arisen as to whether position effects on lateral bud outgrowth exist in this species, and if so, to which causes can they be attributed.

It is possible that position effects on bud growth may result from differences in bud size, age, nutrient/hormone/inhibitor content, differential genome or metabolic expression, or to some other factors. More information and data are needed before definitive explanations can be given. In the present study, the relationships between lateral bud position and outgrowth (over a four-day period) along with initial bud size were investigated in *Ipomoea nil* which has a long main shoot with clearly defined and well-spaced axillary buds.

## MATERIALS AND METHODS

Seeds of *Ipomoea nil* (L.) Roth, strain violet (syn. *Pharbitis nil*) originating from a lot obtained from Marutane Company, Kyoto, Japan, were scarified for 25 min in concentrated $H_2SO_4$ and soaked in running water for 24 hr before planting in peat soil. The plants were germinated and grown under continuous light (mostly cool-white fluorescent, 24-350 µmol $m^{-2}$ $s^{-1}$) in a growth room at 24-30° C. Plants 21- to 28-days-old with at least six nodes were used.

Each plant in groups containing four or more plants was decapitated approximately 2.5 cm above either the first, second, third, fourth, fifth, or sixth nodes, numbering up from the base of the plant and excluding the cotyledonary node. In four replicates of this experiment, decapitations were made above the designated nodes as follows: first trial, nodes 1, 2, 3, and 4; second trial, nodes 1, 3, 4, and 6; third trial, nodes 1, 3, 4, 5, and 6; fourth trial, nodes 1 through 6 (data shown in Fig. 1). All leaves and buds below the point of decapitation were left on the plants. For more accurate determinations of initial bud size, bud length at each node of intact plants was carefully measured using a dissecting microscope (Table 1). This was done on a separate group of plants since such measurements were damaging to the buds. In another experiment in which decapitations were carried out separately above each of the first four nodes, all leaves except for those at the first and the cotyledonary nodes, were removed (Table 2). Lateral bud length was measured daily with a mm ruler over a four- to six-day period in both experiments.

Table 1

*Initial mean lateral bud length in mm (±SD) of intact* Ipomoea nil *plants (22 days old) measured with mm ruler with a magnification of a dissecting scope. The nodes are numbered from the base of the shoot upward excluding the cotyledons.*

| Node | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| | 3.5 ±0.5 | 4.4 ±0.5 | 5.3 ±0.7 | 5.6 ±0.7 | 4.7 ±0.5 | 3.5 ±0.4 |

*n* = 10

A single control curve (Fig. 1) indicating the combined average of all lateral buds at all six nodes was used instead of six control curves because of the essential lack of outgrowth of lateral buds which was observed at all nodes in these intact plants and because these six control curves would have appeared as an identical curve on this cm-scale graph. For the same former reason, separate controls for the buds at each node were not reported (Table 2). The

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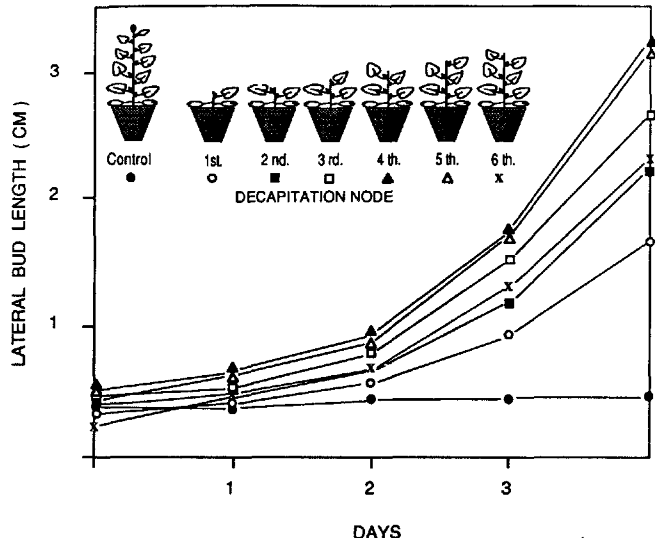


FIGURE 1. The effect of decapitation at different nodes (1-6) on the outgrowth of the highest lateral bud located just below the point of decapitation over a 4-day period, measured with ruler only. There was a minimum of four plants for each treatment. The control curve indicates the mean length of the buds at all six nodes in a group of intact plants.

TABLE 2

*Lateral bud growth (mean bud length, mm ±SD) four days after the shoot was decapitated just above the specified node in plants having all leaves intact compared with lateral bud growth of plants with all leaves removed except for the leaf at the first node (cotyledons were intact). There were a minimum of five plants in each treatment in both groups. The controls indicate the mean length of the buds at all four nodes in intact plants.*

| | | NODE | | | |
|---|---|---|---|---|---|
| | Control | 1 | 2 | 3 | 4 |
| Leaves intact | 4.9<br>±1.2 | 19.2<br>±1.3 | 25.6<br>±5.3 | 28.3<br>±2.2 | 39.2<br>±9.1 |
| Leaves present at first node only | 4.2<br>±0.5 | 15.4<br>±1.4 | 21.3<br>± 0.8 | 27.8<br>± 1.2 | 43.6<br>± 3.9 |

absolute size difference between buds in the first four nodes (Table 1) is negligible compared to the outgrowth of the buds in the decapitated plants (Table 2).

## RESULTS

When the main shoot of a 21- to 28-day-old Japanese Morning Glory plant was decapitated at a location just above any of the first six nodes, it was found that axillary buds at the higher nodes (3 to 6) grew to a greater length over a four-day period than did the buds at the lower nodes (1 and 2) (Fig. 1). The growth of the bud at the first (i.e., the oldest) node was particularly reduced and its initial bud size was also observed to be slightly smaller, statistically so in some cases, than that of those buds of intact plants at the third, fourth, and fifth nodes (Table 1). The buds at the fourth and fifth nodes had elongated to the greatest extent four days after decapitation (Fig. 1). The sixth and youngest bud, although somewhat smaller at the beginning (Table 1, Fig. 1), exhibited vigorous growth during the four days.

When all leaves were removed except for those at the first and cotyledonary nodes, decapitation just above any of the first four nodes resulted in lateral bud outgrowth in the highest node similar to that occurring in plants with all leaves intact (Table 2).

## DISCUSSION

The foregoing results clearly indicate that position effects on lateral bud outgrowth in *Ipomoea nil* do exist. Over a four-day period following decapitation, outgrowth of the axillary buds at the lower and especially the first node is reduced as compared to that at the higher nodes.

In seeking an explanation for the reduced growth of the buds at the lower nodes, it would seem that factors associated with the increased age of these buds and perhaps their slightly decreased initial size, might be considered as possible causes.

In an earlier study with the same species (Cline 1983), it was determined that the lower buds (especially buds at nodes one and two) were smaller than the higher ones except for those near the apex. The smaller size of these lower (older) buds might have been the result of an early reduction or cessation of bud growth, although this was not measured. The quiescent buds at the middle nodes (3, 4, and 5) of intact plants in this previous study continued to grow at a very slow rate even though they had not been forcibly released from apical dominance via shoot inversion.

In another previous investigation (Hosokawa et al. 1990) with Japanese Morning Glory, it was observed in decapitations carried out only 0.5 cm below the shoot tip, that there was significantly reduced total outgrowth in the very small axillary bud located just below the point of decapitation during the first five days as compared with that of the larger lateral buds located somewhat further down the stem when the intervening nodes were debudded. This reduced total growth was probably due in part to the extremely small size (not measured) of the bud at this very early developmental stage. In the present study, the sixth and youngest bud analyzed was located at least 10 cm below the shoot tip and was undoubtedly larger than the bud located just below the 0.5 cm decapitation point mentioned above. The fact that the growth of the sixth bud in our study was as vigorous as it was, can probably be attributed in part to its larger size (as compared to the 0.5 cm bud in that study) and perhaps to the lack of accumulated inhibitors (as compared to buds one and two in the present study).

It is possible that inhibitors such as auxins, abscisic acid (Zieslin et al. 1976, 1978), and/or phenolics might accumulate in the older and lower buds. Suzuki (1990), who finds that buds situated lower on mulberry shoots are more inhibited, also attributes this inhibition to the accumulation of inhibitors. With respect to possible inhibitory effects of auxin, when ($^3$H)-IAA was added near the shoot apex of Japanese Morning Glory, the label gradually moved down the shoot and accumulated in the lower nodes, especially the cotyledonary node (Prasad et al. 1993). Similar patterns of apically-applied auxin label have been found in *Scrophularia arguta* (Miginiac et al. 1978) and *Vicia faba* (Bourbouloux and Bonnemain 1979). The latter workers found a correlation between the degree of inhibition of lateral buds and the amount of label retention in the adjacent nodes.

A determination of whether variations in the number of leaves on a plant (because of decapitation at different nodes as done here) influenced bud outgrowth indicated no significant effect under the conditions of the present study (Table 2) and hence suggested that the amount of photosynthates originating from the cotyledons and first leaf was sufficient for bud growth in any of these experiments.

In summary, it appears from the evidence of this and of other studies that node position did influence axillary bud growth. The lower and older buds on a shoot were more inhibited than the upper and younger buds. That initial bud size was somewhat correlated with bud outgrowth subsequent to the release of apical dominance is evident, but aging and associated factors such as inhibitor accumulation may play a more significant role. Hence, future studies are needed for the elucidation of putative inhibitors located in the lower and older buds of shoots.

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