FACTORS AFFECTING THE ABSCISSION OF THE LEAVES OF *COLEUS BLUMEI*

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Early workers showed that the abscission of leaves is preceded by the formation of an abscission layer at the base of the petiole. The solution of the middle lamella of the cells in this layer causes leaf fall. Sampson (4) working with *Coleus blumei* studied the anatomical and chemical changes taking place during abscission. He reported that the abscission layer begins to form in the third pair of leaves of a plant bearing 8 pairs of leaves, the latter abscissing. The pectase of the middle lamella is changed to pectin and pectic acid causing the separation of these cells. By removing the blades he could accelerate the abscission process in the petioles, the lower ones abscissing in a few days. He reported that no abscission layer was formed in the two youngest petioles below the terminal bud when the blades were removed, and that they failed to abscise. La Rue (3) using *Coleus blumei* and other plants reported that the removal of the blade greatly accelerated abscission but that a small portion of the blade inhibited abscission. He applied indole acetic acid and materials containing growth substances to debladed petioles and abscission was inhibited. He concluded that indole acetic acid inhibited the development of the abscission layer in debladed leaves and that a small quantity of some substance manufactured in the blade, not food, inhibits the abscission of leaves.

Several thousand *Coleus blumei* plants were grown for carrying out this problem. They were grown from cuttings in a greenhouse in flats, later being transferred to 3½-inch pots. The plants selected for use bore 7 to 8 pairs of leaves. Coleus is easily propagated by cuttings and has opposite leaves. The latter made it possible to use various treatments on the half of the leaves and to use the others as controls.

Effect of certain organic acids on the abscission of debladed petioles.—Treating debladed petioles with lanolin containing 1% acetic acid or 1% butyric acid did not inhibit abscission.

Effect of indole acetic acid on the abscission of debladed petioles.—The blades of 8 plants were removed and one petiole of each pair was smeared over the cut end with lanolin containing 1% indole acetic acid and the opposite petiole smeared similarly with plain lanolin. The average time for abscission ranged from 3½ days for the oldest untreated petioles to 19 days for the youngest untreated petioles. The treated petioles abscissed in a much longer time ranging from an average of 26 days for the oldest to 93 days for the youngest. A concentration of 0.1% indole acetic acid was less effective in inhibiting abscission. Freehand and rotary microtome sections showed that abscission layers developed in all the petioles both treated and untreated. Abscission layers were present in various stages in the leaves at the time of treatment from none in the youngest petioles to one practically mature in the oldest. This may explain the slower abscission of the youngest petioles. There was some inhibition of the abscission layers in the treated petioles. This was more evident in the youngest petioles. In the older petioles where the abscission layer was well developed at the time of treatment the inhibition was not so evident. The abscission layers developed in spite of the high concentration of indole acetic acid and formed nearly as rapidly as in the untreated petioles, yet it took 5 to 8 times as long for the treated petioles to abscise. This indicates that the indole acetic acid affects the latter part of the abscission process more than the development of the abscission layer.

Measurement of growth substances diffusing from petioles.—The double decapitation *Avena* technique described by Went and Thimann (5) showed that the most growth substance diffuses from the petiolar end of the third and fourth pairs of leaves. The abscission layer is beginning to form in the third leaf. The amount of growth substance per square centimeter of leaf area, however, was

highest in the youngest leaves and lowest in the older leaves. This agrees with the results obtained by Avery (1) using tobacco. The material diffusing from a petiole treated with 1% indole acetic acid gave a much greater response with *Avena* than the material diffusing from untreated leaves with the blade intact.

Effect of the expanding part of the leaf on abscission.—The place of expansion of *Coleus* leaves was found by marking leaves of various ages into squares and measuring the increase in size of the different squares. The results were much the same as Avery (1) obtained with tobacco, expansion being greatest at the base and least at the tip. The tip of a leaf ceases expanding when it is less than ½ of its final size. To find out if the growth of the leaf had any effect on the abscission process different parts of the leaf blades were removed, the cut edges being smeared with lanolin to prevent desiccation. A leaf with a portion of the base left intact was much more effective in inhibiting abscission than a leaf with the base removed and the tip and midrib left intact. Sections showed that a small portion of the base inhibited the development of the abscission layer while the tip of the blade was less effective. Leaves with ⅞ of the blade removed abscissed in a shorter time than leaves with ½ of the blade intact. And leaves with the base of the blade severed from the midrib but left attached to the intact tip abscissed in a longer time than leaves with only the tip intact. The midrib with all the blade removed did not inhibit abscission.

Completely severing the blades and sealing them to the petiole with a small piece of glass tubing filled with lanolin or agar did not decrease the time of abscission. Leaves with the petioles cut more than halfway through from each side completely severing the vascular system abscissed in a longer time than defoliated leaves.

Conclusions

Removal of the blades of *Coleus* leaves accelerates abscission of the petioles. Application of lanolin containing 1% indole acetic acid inhibits the abscission process partially by inhibiting the development of the abscission layer but mostly by inhibiting the latter part of the abscission process, the solution of the middle lamellæ. The amount of growth substance diffusing from the petiolar end of the leaves is greatest during the time when the abscission layer is beginning to develop. The material diffusing from the base of a petiole treated with 1% indole acetic acid caused a greater response with *Avena* than did the material diffusing from an untreated petiole with the blade intact. The presence of a small portion of the blade will inhibit the development of the abscission layer. The expanding portion of the leaf, i.e., the base of the blade, is more effective in inhibiting the abscission layer than a part of the leaf in which expansion has ceased, i.e. the tip of the blade. These and other experiments indicate that while growth substances may affect the development of the abscission layer other factors or substances formed in the growing portion of the leaf are more important in the inhibition of the abscission of *Coleus* leaves. This factor or substance will not move across an agar or lanolin bridge but does move through living cells.

References

1. Avery, G. S. Jr. 1939. Bull. Gaz. 88:1-14.
2. ——— ——— 1936. Bull. Torr. Bot. Club. 63:319-330.
3. La Rue, C. D. 1936. Proc. National Acad. Sci. 22:254-259.
4. Simpson, H. C. 1918. Bot. Gaz. 66:32-53.
5. Went, F. W. and K. V. Thimann. Phytohormones. New York. 1937.