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Changes in direction of growth as induced by unilateral auxin application to apple shoots

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Abstract

Lanolin paste containing indoleacetic acid, applied unilaterally to the elongating internodes of apple shoot, caused a marked change in its direction of growth. Measurements taken during autumn have shown that the treated internodes were not longer than those of control shoots. There was a short zone a few cm above the treated area with inhibited internodes and small leaves. Possibilities for practical application of the described method exist.

INTRODUCTION

A method commonly used to change the direction of shoot growth is that of making a cut above the chosen bud or by binding the shoot to another part of a tree or to the wire. Auxin paste was used by Verner (1938, 1955), Preston and Barlow (1951), Jankiewicz et al. (1961), Jankiewicz (1964) and Łysenko (1956) to widen crotch angles in fruit trees. Auxin applied to the upper side of a young lateral shoot causes it to bend downward thereby increasing the crotch angle. It seemed interesting to check if auxin paste might be used to change the direction of growth in an upward or downward as well as sideward direction.

MATERIAL AND METHODS

The experiment was conducted in a nursery on Kaiser Wilhelm trees during their second year of growth. Shoots were treated with auxin paste when about 12 cm long and when possessing about 5 - 8 leaves. Only the 2nd or the 8th shoot was treated, using only one shoot per tree. Part of the shoots were treated with the auxin paste on their upper side, part

on their lower side, and part on a lateral side. The paste consisted of anhydrous lanolin containing 0.8% of indoleacetic acid (IAA). On each shoot only two young, elongating internodes were treated, which were 0.8 - 1.8 cm long at the time of auxin administration. The experiment was set up in 7 randomized blocks using single trees as plots. The final measurements were taken in late July and in autumn.

Another experiment was set up in June on 24 water sprouts growing straight upward on large, uppermost, horizontal limbs of a 25-yr-old Reneta Kurska tree. The shoots were on the average 9 cm long and had 7 leaves. Half of them were treated with a lanolin paste containing 1% IAA. Three internodes 5 - 30 mm long were treated per shoot. Final measurements were made in autumn.

RESULTS

The responses of the 2nd shoots of Kaiser Wilhelm trees

The shoots showed curvatures at the place where they were smeared with auxin paste. Those treated on the upper side bent downward by about 25°; those treated on the lateral side bent 20° toward the opposite side and also downward by 16° — thus showing a typical auxin-induced torsion (S n o w 1962); the side treated with auxin exhibiting the tendency to become the upper side. Shoots smeared on the lower side bent upward by 17° at the same time showing a sideward torsion of 20°. The control shoots showed a slight downward bending of 3°. The treated internodes were of equal length or slightly shorter than those of the control shoots. The total length of the treated shoots was only slightly less than that of the controls. The number of leaves was the same in the case of both groups. The treatment had no influence upon the basal crotch angles of the shoots showing that the effect of auxin upon bending is rather local, and confined to the zone of elongation. An additional effect of auxin treatment was the inhibition of elongation of internodes 5. - 7. above the treated zone. Corresponding leaves were also smaller than on the controls. The leaves below and above this "zone of inhibition", including the leaves attached to the treated part of the shoot did not differ from analogical leaves of the control shoots. The internodes below and above this "zone of inhibition" were also of normal size.

The responses of the 8th shoots of Kaiser Wilhelm trees

These shoots bent much more under the influence of auxin than the 2nd shoots. Those smeared on the upper side bent downward by 24°; those smeared on the lateral side bent sideward, in the opposite direc-

tion by 22° and at the same time showed a downward torsion of 21°. Shoots treated on the lower side showed upward bending of 40°. The inhibitory effects of auxin treatment were very marked in these shoots — treated internodes were markedly shorter than those of control shoots. Internodes 2. - 5. above the treated portion were much shorter and the corresponding leaves much smaller than those of the control shoots. Internodes of the treated shoots above the "zone of inhibition" were as long as those of control shoots but the leaves were sometimes smaller. Treated shoots as a whole were shorter and had smaller number of leaves than the controls. They often had formed prematurely terminal bud.

The responses of water sprouts of Reneta Kurska

These shoots showed very marked curvatures on an average of 93° at the place where they were treated. However, in their more distal part recompensatory upward curvatures were observed averaging 30°. The treated branches were on the average 28 cm long and possessed 15 leaves, whereas the control shoots were 52 cm long and possessed 25 leaves. The treated internodes were as long as corresponding internodes of the control shoots. The "zone of inhibition" with short internodes and small leaves was distinct in all treated shoots some cm above the treated zone.

DISCUSSION

The results presented here show that it is possible to induce a change in the direction of shoot growth; however, auxin treatment always evokes more or less pronounced inhibitory effects upon growth.

Since the internodes smeared with auxin were never longer than those of control trees and often were shorter, it must be assumed that the bending was not achieved by stimulation of the treated side but through more inhibition of the opposite side. This peculiar phenomenon needs more detailed study. It was also interesting that within 5 - 12 hours after treatment the shoots were very markedly bent even in Kaiser Wilhelm trees (by 40 - 60°) but during following hours their angles of curvature diminished.

Internodes situated some distance above the place of auxin application were markedly inhibited, and corresponding leaves were also smaller than normal, or even transformed into scales. The leaves and internodes formed above this "zone of inhibition" were normal. This indicates that the action of applied auxin was only temporary and affected only those parts of the plant which were in early stages of morphogenesis at the time of treatment. The finding that auxin induces inhibition above the place of treatment supports the statement of Fulford et al. (1968)

that in a non injured shoot a large proportion of applied auxin moves acropetally. Possibly the acropetal and basipetal movement takes place in different tissues as is suggested by papers of Bonnemain (1971) and of Morris and Kadir (1972).

From a practical point of view is important that a marked change in the direction of growth may be evoked by unilateral auxin treatment. Further studies are needed to show if this method may be applied to change some of the water sprouts into horizontal branches to replace old bearing branches.

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REFERENCES

Bonnemain J. L., 1971, C. R. Acad. Sci. Paris (D) 273: 1699 - 1702.

Fulford R. M., Quinlan J. D., Lacey H. J., Barlow H. W. B., 1968, [In:] Wrightman F., and Settefield G., (ed.) Biochemistry and physiology of plant growth substances, Ruge Press, Ottawa.

Jankiewicz L. S., 1964, Prace Inst. Sad. (Warszawa), 8: 30 - 47.

Jankiewicz L. S., Szpunar B., Barańska H., Rumplowa R., 1961, Acta Agrobot. 10: 151 - 171.

Morris D. A., Kadir G. O., 1972, Planta (Berl.) 107: 171 - 182.

Łysenko B. F., 1956, Dokl. T.S.Kh. A. 36: 95 - 101.

Preston A. P., Barlow H. W. B., 1951, Ann. Rep. East Malling Res. Sta. 1950, 76 - 79.

Snow R., 1962, Geostrophism [In:] Ruhland W. (ed.) Encyclopedia of plant physiology, 17(2): 378 - 389.

Verner L., 1938, Proc. Amer. Soc. Hort. Sci. 36: 415 - 422.

Verner L., 1955, Univ. Idaho Agr. Exp. Sta. Res. Bul. 28: 1 - 31.

Zmiany kierunku wzrostu pędu jabłoni wywołane jednostronnym stosowaniem auksyny

Streszczenie

Pasta lanolinowa zawierająca kwas indolooctowy przyłożona jednostronnie do pędu jabłoni wywołuje istotne zmiany w kierunku jego wzrostu. Pomiary wykonane w jesieni wykazały, że traktowane międzywęźla nie były dłuższe od kontrolnych. Powyżej miejsca traktowanego (kilka cm) występował krótki odcinek o zahamowanych międzywęźlach i małych liściach. Przedyskutowano możliwości praktycznego wykorzystania tego zabiegu.