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Physiological correlations and bud dormancy in the apple tree (*Malus domestica* Borkh.)

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Introduction

During their autumn rest period, terminal and axillary buds of apple trees exhibit different behaviours: the terminal bud is always much more dormant than the axillary ones so that one can wonder whether the latter are not simply inhibited by physiological correlations (Williams *et al.*, 1979; Mauget and Rageau, 1988). To check this hypothesis, the following experiment was carried out on apple trees, cultivar *Golden delicious.* Long shoots were defoliated and/or pruned in fall and early winter in order to release buds from all physiological inhibitive influences (apex, leaves). The subsequent dormancy of buds on control and treated shoots was studied from fall until budburst on the trees.

Materials and Methods

The trees (15 yr old) were grown in an orchard located in the area of Clermont-Ferrand. Groups of long shoots on the trees were: a) defoliated in September and in October; b) pinched (elimination of the terminal bud) or pruned in their middle part monthly from September until January; or c) simultaneously defoliated and pruned or pinched in September and October.

Bud dormancy on control and treated shoots was studied with the method of isolated node cuttings. For each treatment, about 10 shoots were collected at intervals of 15 days and were cut into 8 cm cuttings on which a single node was left. The cuttings were stood in water at a constant temperature of 20°C under long days of 16 h. The time needed for budburst of each bud was recorded by daily observation. The average state of dormancy of the population of sampled buds was quantified by the mean time of budburst *(MTB)* expressed in days; this was the arithmetic mean of the time to budburst for each bud from a given population and at each date of collection. The higher the *MTB,* the more dormant the buds. Distal, median or basal buds could be studied separately.

Results are expressed as the change of *MTB* during the vegetative rest period. This described the time course of dormancy.

Results

Effects of defoliation (Fig. 1a)

Only changes in dormancy of lateral buds located near the apex part are shown. These buds became more dormant after defoliation, particularly after October treat-

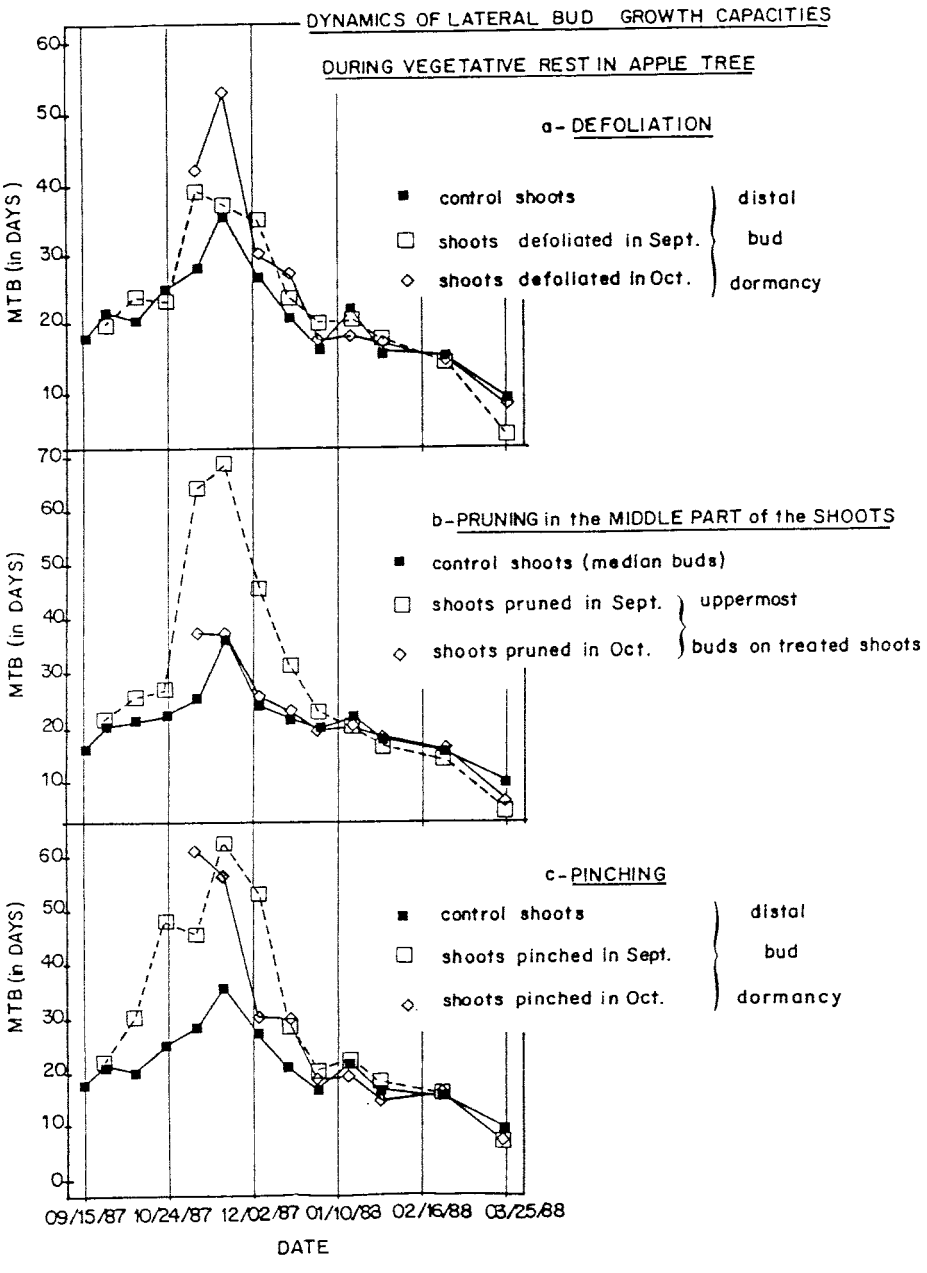
DYNAMICS OF LATERAL BUD GROWTH CAPACITIES
DURING VEGETATIVE REST IN APPLE TREE
a- DEFOLIATION
control shoots
shoots defoliated in Sept.
shoots defoliated in Oct.
distal bud dormancy
b-PRUNING in the MIDDLE PART of the SHOOTS
control shoots (median buds)
shoots pruned in Sept.
shoots pruned in Oct.
uppermost buds on treated shoots
c-PINCHING
control shoots
shoots pinched in Sept.
shoots pinched in Oct.
distal bud dormancy
MTB (in DAYS)
09/15/87 10/24/87 12/02/87 01/10/88 02/16/88 03/25/88
DATE

Fig. 1.

ment. Behaviour of other buds on the stem was hardly affected by this treatment.

Effects of pruning and pinching (Fig. 1b and c)

Only the treatments done in September and October modified the course of bud dormancy (*i.e.,* before the peak *MTB* in late November). The intensity of dormancy in the uppermost buds was considerably increased for treated shoots. These effects were more important for buds on shoots treated in September than on those treated in October. Both these treatments (and also defoliation) accentuated a bud dormancy gradient along the stem. The increase in intensity of lateral bud dormancy was slightly more important on simultaneously defoliated and pinched or pruned shoots than on treated shoots (Fig. 1a or b) (data not shown).

The main differences between *MTB* values for control and treated shoots in mid-fall were statistically significant (Mann and Whitney *U* test, 5% level).

Discussion

Removing inhibitory influences from the apex and leaves did not decrease the extent of dormancy; on the contrary, the intensity of bud dormancy was increased by September and October treatments. The inhibited state of the lateral buds in apple could be responsible for the shallow dormancy exhibited by these buds. Nevertheless, the potential for these buds to grow out remained weak.

These results are in agreement with the hypothesis developed by Barnola *et al.* (1976) for *Corylus.* These authors suggest that the correlative influence from the apex and properties associated with the position of the lateral bud could be factors that prevent acquisition of strong dormancy. The situation of the terminal buds which exhibit strong dormancy, could be different.

Since the uppermost buds on apple shoots pinched and defoliated in the fall grow out rapidly when detached from the trees (Paiva and Robitaille, 1978; Williams *et al.,* 1979; Latimer and Robitaille, 1981), a factor associated with the whole plant (and to a lesser extent low temperature) is necessary to increase the dormancy of lateral buds. The induction of strong dormancy in the lateral buds can be considered a good means to study, using structural and biochemical approaches, the mechanisms involved in bud dormancy in apple trees.

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