EFFECTS OF PACLOBUTRAZOL ON STOMATAL SIZE AND DENSITY IN PEACH LEAVES

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Abstract

To study the stomatal contribution to total leaf gas exchange in leaves of paclobutrazol-treated peach trees (*Prunus persica* (L.) Batsch), counts and measurements of stomata were made. Peach trees (cv. Catherine) were treated with different doses of paclobutrazol at bloom, and later in summer, counts of stomata per unit area of leaf showed that the density increased linearly with the doses, while the length of the stomata also decreased linearly.

1. Introduction.

Paclobutrazol is a plant growth inhibitor that effectively controls vegetative growth in peach and other stone fruit species (Blanco, 1987; 1988, Martin et al., 1987). However, paclobutrazol not only affects nutrient distribution among the vegetative and reproductive organs, but also promotes changes in water content in different organs. Besides, paclobutrazol is known to affect photosynthesis. Although DeJong and Doyle (1984) found no apparent decrease in leaf photosynthetic rate, most authors think that there is an indirect effect, as the concentration of chlorophyll per leaf area is increased. However, experiments carried out at our laboratory demonstrate a direct effect of paclobutrazol, modifying the efficiency of PS I and II. Nevertheless, total photosynthetic yield decreases in paclobutrazol-treated plants, partly due to reductions in total leaf area, but also by other mechanisms of control. We have studied the stomatal contribution to total leaf gas exchange by counting and measuring the stomata in leaves of peach trees.

2. Materials and Methods.

The experiment was carried out in a commercial orchard, owned by the ALM Group in Fuentes de Ebro (Spain). Adult peach trees cv. Catherine grafted on Nemaguard rootstock of 41.0 ± 3.2 cm trunk girth were treated with 0, 0.25, 0.5, 1 and 2 g per tree of paclobutrazol solved in 1 l of water and applied at bloom time, onto the soil as a trunk drench. The treatments were applied as randomised blocks with 3 replications, the tree being the experimental unit. The orchard was subjected to the usual management practices of the area, including hand fruit thinning and flood irrigation.

By midsummer, three leaves per tree were sampled at random, carefully dried and observed under a scanning electron microscope. Three photographs per leaf were used to record the number of stomata inside a square of known area, and also the length of the

stomata. Three counts of stomata were made and ten length measurements were recorded per photograph. Analysis of data was made by regression against the paclobutrazol doses applied.

3. Results and Discussion.

A general reduction in leaf area following the application of paclobutrazol has been found. However, an increase in photosynthetic pigments generally occurs (Wang et al., 1985; Monge et al., 1994), and the efficiency of photosystems I and II appears to be increased by paclobutrazol (unpublished data). To study the stomatal contribution to total leaf gas exchange by counting and measuring the stomata in leaves of peach trees.

The density of stomata increased significantly ($P \leq 0.05$) with increasing doses of paclobutrazol applied to the tree (Figure 1). The values obtained, plotted against the doses of paclobutrazol applied per tree showed a linear pattern of behaviour ($y = 234.0 + 54.7\ x$; $r = 0.803$).

On the contrary, measurements on stomata length showed a significant decrease ($P \leq 0.001$) in the values with the increase in the doses of paclobutrazol applied per tree (Figure 2). Regression analysis of the length against the doses, showed a linear pattern of behaviour ($y = 33.79 - 2.79\ x$; $r = - 0.813$).

The proportional increase in stomata density (47 % greater in leaves from trees treated with 2 g paclobutrazol) is far greater than the proportional decrease in stomata size (19 % smaller in length). This is similar to the effect found by Aguirre and Blanco (1992) on xylem vessel size and density of the current year shoots. The changes promoted by paclobutrazol in the developmental patterns of the xylem and in the leaf may account for the changes in the plant water status: the increase in leaf water potential (DeJong, 1986) and the increase in water content in fruits and shoots of paclobutrazol-treated peach trees.

The changes in stomata density and size induced by paclobutrazol (Plate 1) could lead to a greater level of leaf gas exchange, and, thus, to increase the photosynthetic yield per unit leaf area. However, leaf gas exchange appears not to change following the application of paclobutrazol according to DeJong and Doyle (1984), presumably due to the induction of stomata closure by triazoles (Santakumari and Fletcher, 1987). This, together with the reduction in total leaf area, would explain the reduction in total dry matter production recorded when peach trees are treated with this plant growth inhibitor.

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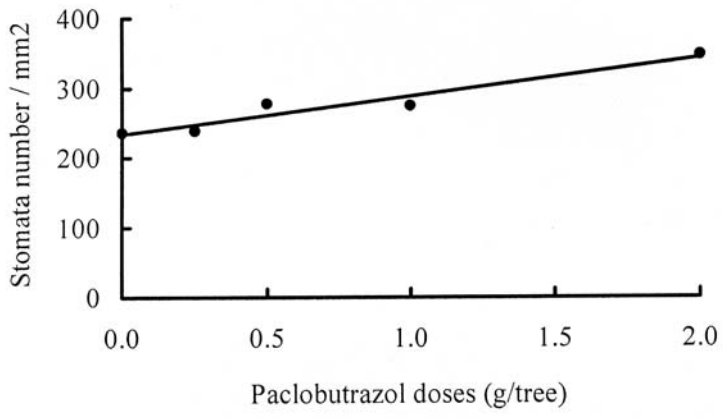


Figure 1 .- Stomatal density in leaves of ‘Catherine’ peach trees treated with different doses of paclobutrazol

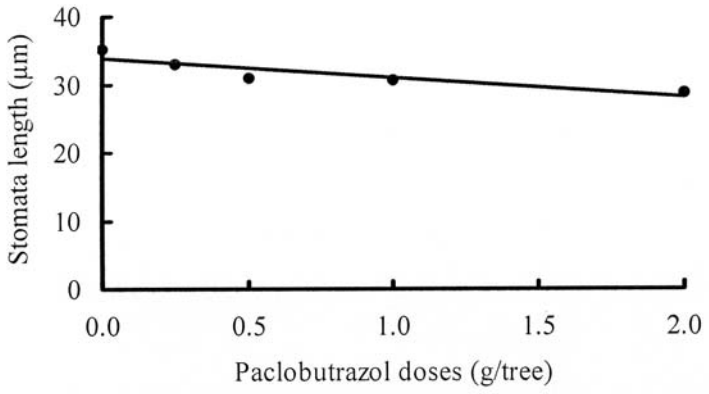
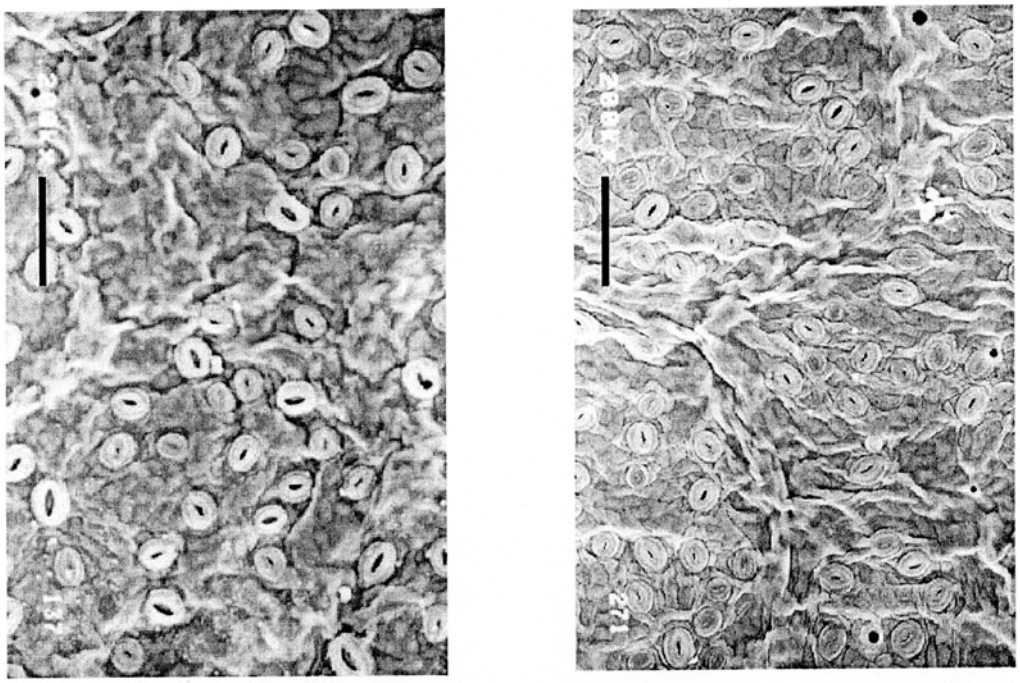


Figure 2.- Effect of different doses of paclobutrazol on the length of stomata in leaves of 'Catherine' peach trees.



(a) (b)

Plate 1.- SE micrograph of (a) a leaf from an untreated tree and (b) a leaf from a peach tree treated with 2 g paclobutrazol. (Bar equals 100 μm)