

Pollination biology of *Persea americana* Fuerte

LA COETZER and PJ ROBBERTSE

Margaretha Mes Institute for Seed Research,
University of Pretoria, Pretoria 0002, RSA

SYNOPSIS

In vivo germination tests were conducted with pistils and pollen obtained from boron-deficient and boron-supplemented trees. Boron-sufficient pollen on boron-deficient pistils gave significantly lower germination figures than boron-deficient pollen on boron-sufficient pistils.

INTRODUCTION

Disappointingly low avocado fruit yields are often encountered (Bergh, 1967; Tourer & Gottreich, 1975 and Sedgley, 1977) and this has led to research in various fields in an effort to solve the problem. In the morphological discipline, research has been concentrated on the flowers, especially regarding the ovule (Tomer & Gottreich, 1975, 1976 and 1978), stigma and style (Sedgley & Buttrose, 1978 and Sedgley, 1979a), pollination (Higgins, 1917; Robinson & Savage, 1926 and Schroeder, 1954) and pollen tube-growth (Sedgley, 1976, 1977 and 1979b and Sedgley & Grant, 1982).

Avocado flowers periodically close and re-open, resulting in alternating female and male phases. The flowers are thus functionally dichogamous, representing a kind of temporal dioecy which is well known for members of the Lauraceae (Kubitzki & Kurz, 1984).

The pollen-ovule ratio is comparatively high (Coetzer & Robbertse, 1986) and one would expect that this abundance of pollen together with the phased sexuality of the flowers, should promote fertilisation and result in prolific fruit formation. The fact that fruit yields are nevertheless often low, compelled an investigation into the success rate of pollination.

It is well known that various concentrations of boron have an effect on *in vitro* germination of pollen in general (Stanley & Lichtenberg, 1963). The influence of boron on avocado pollen in particular however, has not been researched. This paper represents results of an investigation into the effect of boron-deficiency and -sufficiency on avocado pollen germination and pollen tube-growth in the styles.

MATERIALS AND METHODS

The experimental material was obtained from seven-year-old grafted avocado trees of the cultivars Fuerte and Hass from the Westfalia Estates, Duivelskloof, in the Northern Transvaal, Republic of South Africa. Trees with leaf analysis registering 15 ppm boron called 'healthy' trees and trees exhibiting boron-deficiency, with leaf analysis registering 7 ppm boron, were selected from the orchards.

Flowers from both boron-sufficient and boron-deficient trees were collected prior to the first opening and placed in 1,5 per cent agar medium in Cooke's microtiter trays for 14 hours before being hand-pollinated with fresh pollen. Boron-supplementing tests were done on flowers placed in the same agar medium containing 1,60 m mol dm³ boron. The pollinations were divided into two experiments with three treatments each. At least 50 flowers were pollinated for each treatment.

Experiment 1 was conducted using Hass pollen and Fuerte pistils throughout. All pollen was procured from healthy trees, but the pistils used were obtained as follows:

Experiment 1.1 - pistils from healthy trees

Experiment 1.2 - pistils from boron-deficient trees placed in boron-supplemented agar

Experiment 1.3 - pistils from boron-deficient trees

Experiment 2 was conducted using Hass pistils and Fuerte pollen throughout. All pistils were obtained from healthy trees, but the pollen varied:

Experiment 2.1 - pistils placed in boron-supplemented agar and pollinated with pollen from boron-deficient trees

Experiment 2.2 - pistils pollinated with pollen from boron-supplemented trees

Experiment 2.3 - pistils pollinated with pollen from boron-deficient trees.

After pollination, flowers were kept in a growth cabinet for 24 hours at 20°C before fixing in Carnoy's fluid. The pistils were removed and processed for fluorescence microscopy using Aniline Blue according to the method of Martin (1959). Preparations were studied and photographed using a Nikon Optiphot epifluorescence microscope with ND2 and ND4 excitation filters, a UV (420) barrier filter and a Nikon HBO - 100 W/2 mercury lamp. The pistils were observed for the number of pollen tubes in the styles. The data was statistically analysed using a single factor variance analysis and Duncan's multiple range test for variables.

RESULTS

The main aim in Experiment 1 was to determine the effect of boron on the functioning of the pistil in maintaining pollen tube-growth up to the ovule. In Experiment 2 the emphasis was on the influence of boron on pollen germination and pollen tube-growth. The results are summarised in Figure 1.

DISCUSSION

Pistils from healthy trees (Experiment 1.1) pollinated with pollen from boron-sufficient trees, showed significantly more pollen tubes per style than pistils from boron-deficient trees (Experiment 1.3) pollinated with the same boron-sufficient pollen. In Experiment 1.2 the addition of boron to the agar resulted in a dramatic increase in the number of growing pollen tubes per style.

This indicates that the boron available in optimum quantity has a positive influence on pollen tube-growth. Although a small number of pollen grains germinate on the boron-deficient stigmas, most of the pollen tubes stop growing at approximately the base of the stigma, whereas pollen tubes exhibit active and prolonged growth in styles of flowers from boron-sufficient trees. Sedgley (1979a) reported that, immaterial of the number of pollen grains germinating on the stigma, only a few pollen tubes will exhibit prolonged growth and eventually reach the ovule. It was found that cessation of pollen tube-growth was particularly marked in boron-deficient pistils while in pistils from boron-supplemented trees, significantly more pollen tubes showed active and prolonged growth in the style.

In Experiment 2, Hass pistils from boron-sufficient trees were used. In Experiment 2.2, where healthy pollen was used, the pollen tube-growth was significantly better than in Experiment 2.3 where the same healthy pistils were pollinated with boron-deficient pollen. In Experiment 2.1, where the same healthy pistils were further supplemented with boron and then pollinated with boron-deficient pollen, the pollen tube-growth was even better.

If one compares Experiment 1.3, where the pistils were deficient in boron, and Experiment 2.3, where the pollen was boron-deficient, it is evident that, as the pollen tube-growth is significantly lower in the boron-deficient pistils than with boron-deficient pollen, the negative influence of the boron-deficiency is more pronounced on the pistil than on the pollen. This deduction is supported by the dramatic increase in pollen tube-growth when boron is added to boron-deficient pistils.

It can thus be concluded that the addition of boron to avocado flowers has a significantly positive effect on the in vivo growth of the pollen tubes.

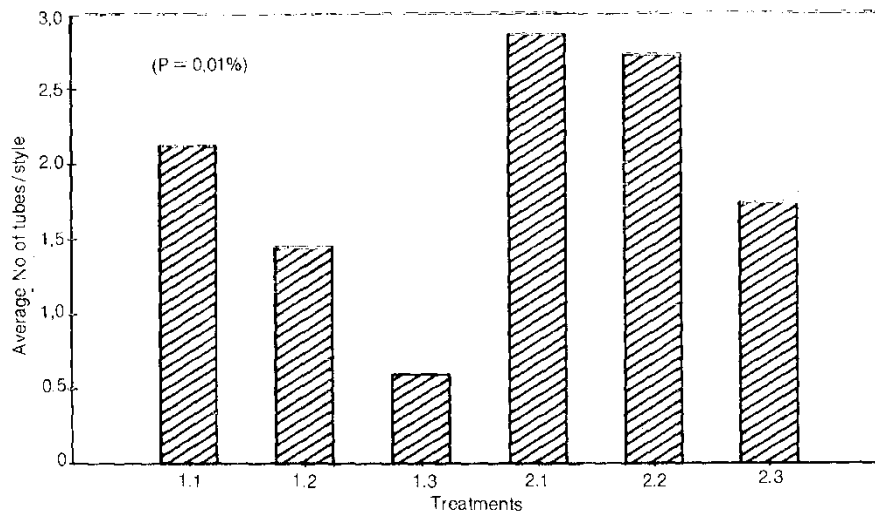


Fig 1 Pollen tube-growth in avocado styles of Fuerte (treatments 1.1, 1.2 & 1.3) and Hass (treatments 2.1, 2.2 & 2.3). See Material and Methods for X-axis legend.

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*In Afrikaans