

ECOPHYSIOLOGICAL STUDIES OF THREE cvs OF Persea Americana (Mill.) EMPHASISING PHOTOSYNTHESIS AND INTERNAL WATER RELATIONS

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INTRODUCTION

The avocado industry has become important in South Africa, from both an export and local market point of view. According to South African Avocado Growers Association statistics, total 1977 production was 19 000 tons, of which 4 810 tons was exported, a 5 per cent, increase on 1976. This is likely to expand even further judging by new plantings. As such, the industry must be run on sound lines based on research, to ensure maximum profits.

The major avocado cultivars grown in South Africa are Fuerte, Edranol and Hass. As a result, all three are considered in this study. Of the three, both Hass and Edranol are considered to be of the Guatemalan horticultural race, while Fuerte is thought to be a natural hybrid between the Guatemalan and Mexican races (Bergh, 1975).

All three originate in highland forest regions of Guatemala and southern Mexico, and as such are adapted to highland tropical and cool subtropical moist and humid climates (Wolstenholme, 1977a). They have the reputation for being particularly sensitive to high temperatures and moisture stress. However, very little recent critical work of a practical nature, apart from a report by Sterne, Kaufmann & Zentmyer (1977) has been published, and even then the work done by these authors was on a Mexican type cultivar not commonly grown in South Africa.

The avocado grower in common with most agricultural enterprises is faced with increased production costs, while in real terms income is often static or diminishing. The only way then of increasing profits (the overall aim of any business enterprise) is to increase productivity. In the past, emphasis has been on increasing tree production but as Cain (1969) pointed out, production per unit area is the most important criterion for orchard profitability. Land is probably the farmers greatest fixed cost, yet Cain (1970) found that in widely spaced standard apple orchards only 40 per cent, of the land was effectively utilized in the long term. The problem could be even more acute in the avocado, owing to its shorter commercial life. The only answer would appear to be closer spacing, especially in the earlier years, with tree pruning and removal when shading and crowding occurs. In California double planting is now common practice (Lee, 1974). The question however, is how close to plant and at what stage crowding becomes of economic importance under South African conditions. The effect of shading on avocado tree performance is a controversial topic, and in the absence of research

guidelines, tree espacement and thinning programmes are largely subjective. This need not necessarily be the case, as a number of mathematical models are available which could be adapted to fit the situation, and thereby produce a theoretical prediction of orchard performance under any particular set of conditions. The environmental requirements of the trees must however be known. The large leaves and very large seeds, as well as what is known about the native habitats of the cultivars in question are, on basic ecophysiological principles (Jansen, 1975; Larcher, 1975), suggestive of evolutionary adaptation to a shaded, humid forest environment, suggesting that this crop may be adapted to close spacing. On the other hand the leathery nature of the mature leaf is indicative of at least fair tolerance of drought (from a survival point of view).

Together with incoming solar radiation, water relations are probably the most important environmental variables affecting plant productivity. By depressing photosynthesis, water stress can affect all facets of plant productivity. Further, water stress can affect other parameters adversely, resulting for instance in excessive leaf temperature. No study of tree productivity can therefore be realistic without examining internal water relations.

Water relations are probably of special importance for the South African avocado grower, who is faced with a dilemma. He must compromise between the limited root system and the apparently high water requirement of the tree (Bredell, 1971), and the high oxygen requirement of the roots (Curtis, 1949) and their intolerance of poor drainage especially in the presence of the soil fungus *Phytophthora cinnamomi* (Wager, 1942; Zentmyer, Paulus, Gustafson, Wallace & Burns, 1965). It is therefore not outside the bounds of possibility that in South Africa water stress is a major component in the suppression of orchard productivity.

The aim of this study was thus to examine aspects of the ecophysiology of the three major avocado cultivars grown in South Africa, with special attention being given to incident solar radiation, temperature and water relations, in the hope of providing some answers to the parameters required for an objective orchard design system.