QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES
DIVISION OF PLANT INDUSTRY BULLETIN No. 590

PLANT WATER STATUS OF APPLE TREES AND ITS MEASUREMENT IN THE FIELD. 7. WEEK-TO-WEEK VARIATIONS IN THE EARLY MORNING PLANT WATER STATUS OF THREE VARIETIES

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SUMMARY

Leaf water potential, fruit water potential and leaf infiltration scores were used as indices of the plant water status of three apple varieties, during one growing season.

The highest and lowest leaf water potentials recorded, during the early morning period, were respectively for Delicious -9 atm and -20 atm, Jonathan -3.5 atm and -19 atm, and Granny Smith -4 atm and -13 atm.

Mean fruit water potential was similar for Granny Smith and Delicious, but considerably lower for Jonathan.

Leaf infiltration scores and leaf water potential maintained a close relationship, while leaf and fruit water potentials showed considerable divergence.

These data serve to show the magnitude of plant water stress which apple trees have to contend with in an almost normal growing season in Queensland.

I. INTRODUCTION

In the 1967-68 growing season, in the Stanthorpe district of south-eastern Queensland, weekly records were kept of leaf water potential, fruit water potential and infiltration score, for the apple varieties Delicious, Jonathan and Granny Smith. These data were accumulated to demonstrate the plant water stress experienced by apple trees in the district during the September to April growing season. In this particular season rainfall received was 2·8 in. above normal, and evaporation from a Class A pan was 10·4 in. above the estimated mean tank evaporation for this period.

II. METHODS

Leaf and fruit water potentials were measured each week during the third hour after sunrise, using the dye technique (Chapman 1970*a*, 1970*b*). Infiltration scoring for stomatal aperture was carried out at the same time using general-purpose lighting kerosene (Chapman 1968). Liquid medicinal paraffin was not used for scoring, as in later work (Chapman 1970*c*), because at this stage testing with paraffin had not been tried.

Four replicates each of three trees were sampled on each occasion for the individual varieties. Twelve leaves and six fruits from each replicate provided the material required for leaf and fruit water potential determinations. For infiltration scoring, three leaves on each tree were tested and the mean of three trees provided the replicate values.

III. RESULTS AND DISCUSSION

Figures 1–3 show the results of each measurement for the three varieties collectively, while Figures 4–6 show the same results for each variety in turn. This presentation of data in two forms has been made for convenience in interpretation.

In Figure 1, data showed that Delicious had leaf water potentials lower than those of both Jonathan and Granny Smith, and Jonathan had potentials lower than those of Granny Smith. The highest leaf potentials recorded for the whole period for the three varieties were Delicious —9 atm, Jonathan —3·5 atm and Granny Smith —4·0 atm, while the lowest values were —20 atm, —19 atm and —13 atm respectively.

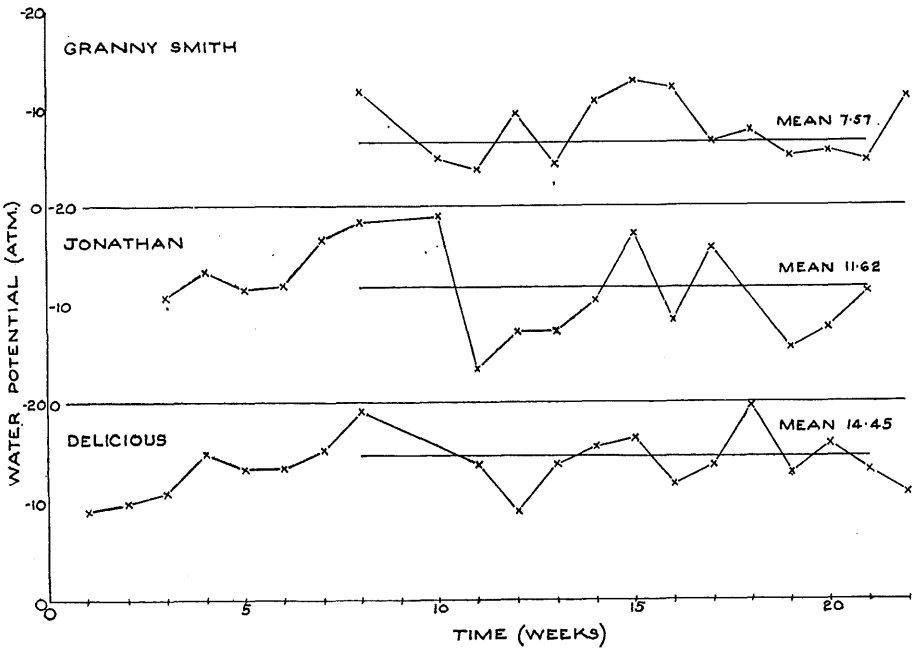

Fig. 1.—Weekly leaf water potentials for three apple varieties during the growing season.

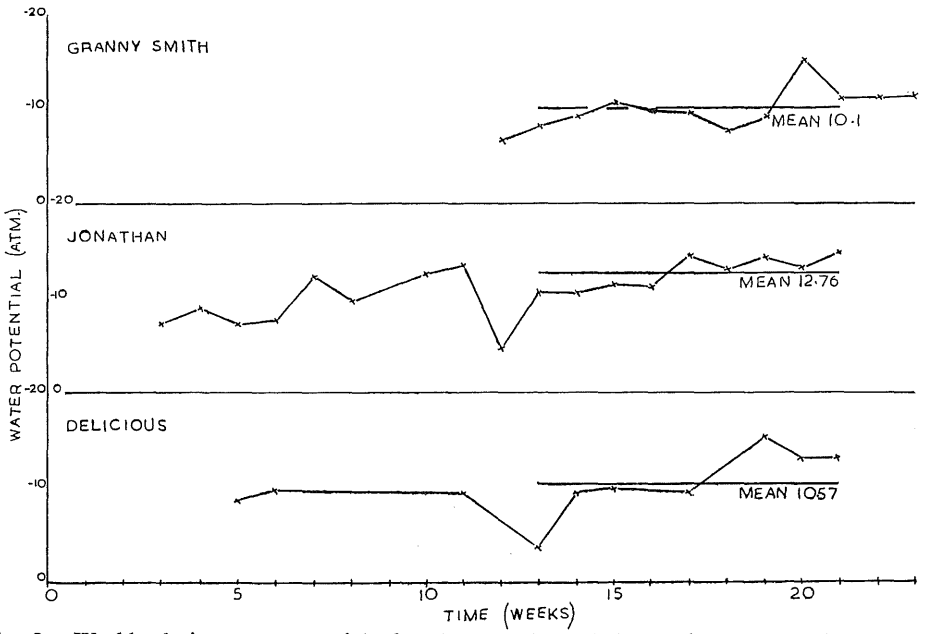

Fig. 2.—Weekly fruit water potentials for three apple varieties during the growing season.

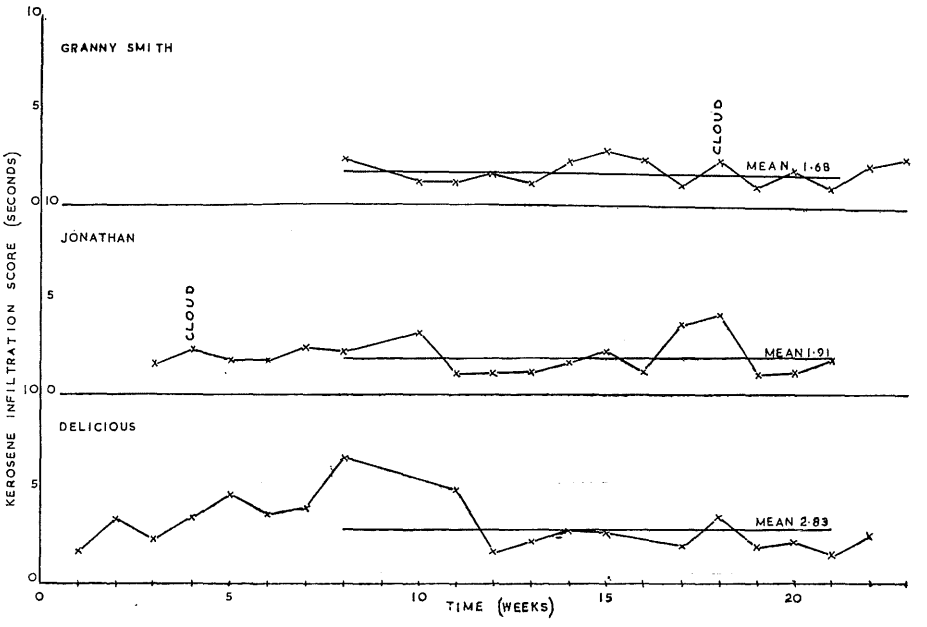

Fig. 3.—Weekly infiltration scores for three apple varieties during the growing season.

With fruit potentials (Figure 2), Jonathan developed mean values lower than those of Granny Smith and Delicious, while the last two varieties had similar potentials.

The magnitude of the fluctuations in leaf and fruit water potential was similar for Granny Smith and Delicious, but for Jonathan leaf potentials varied over much wider limits than did those of the fruits.

Figure 3 demonstrates that infiltration scores for comparable periods followed a similar pattern to leaf water potentials in Figure 1. However, while mean values for Delicious were significantly higher than those of Jonathan and Granny Smith, these varieties had similar scores. This latter effect was attributed to the cloudy day, which produced higher scores with Granny Smith.

It should also be pointed out that the kerosene infiltration technique is somewhat less accurate than the paraffin infiltration method (Chapman 1968, 1970*c*).

For observation purposes, Figures 4–6 show how the various plant water status indices vary together for each of the three varieties. Leaf water potentials and leaf scores maintained a fairly close relationship, whereas leaf and fruit water potentials varied more or less independently.

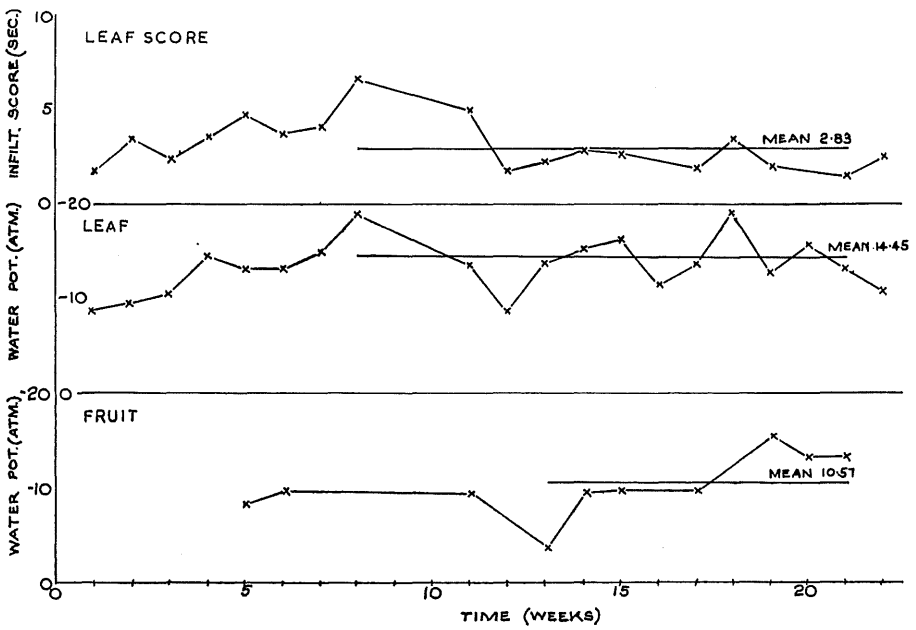

Fig. 4.—Weekly water stress measurements for Delicious.

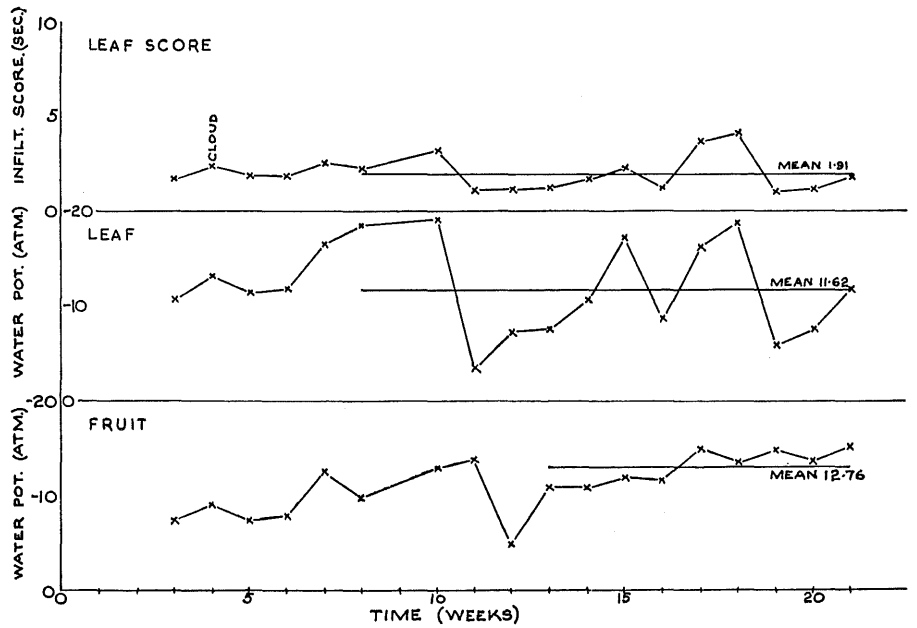

Fig. 5.—Weekly stress measurements for Jonathan.

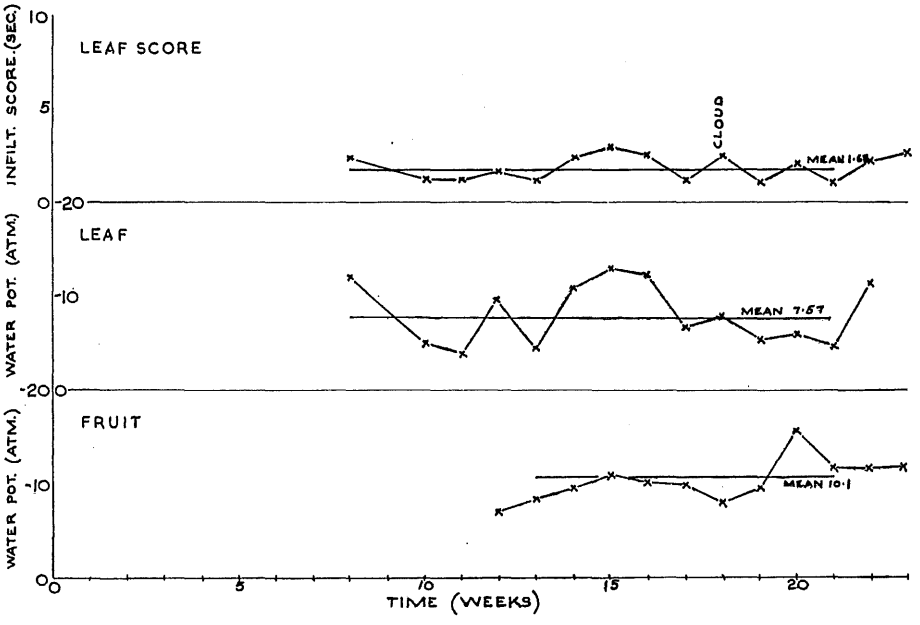

Fig. 6.—Weekly water stress measurements for Granny Smith.

It seems apparent that the water potentials developed in both fruit and leaves during the early morning period can be as low as —20 atm. This incomplete overnight recovery was probably caused by inadequate soil moisture. coupled with high evaporative conditions on the previous day.

As far as can be determined, no information of this type has been accumulated before with pome fruit trees, except for work by Goode (1968) and Klepper (1968), who followed some diurnal trends with apples and pears respectively.

To the author the effects of such stresses recorded here on yields and tree growth are obvious in the Stanthorpe district, but just how stress influences growth and yield through its effect on basic physiological processes requires further investigations. Such investigations will be useful in defining critical periods for water stress which will be important in using available water more efficiently.

IV. ACKNOWLEDGEMENTS

The author wishes to thank Miss E. A. Goward, Biometry Branch, who carried out statistical analyses, and Dr. G. L. Wilson, University of Queensland, for helpful advice and criticism during the course of this work. The help of Mr. G. J. Funk, of the Granite Belt Horticultural Research Station, with field and laboratory work is also gratefully acknowledged.

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(Received for publication April 8, 1971)

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