

AERIAL PHOTOGRAPHY AND ROOT DISEASES

JL EHLERS and JM KOTZÉ

DEPARTMENT OF MICROBIOLOGY AND PLANT PATHOLOGY, UNIVERSITY OF PRETORIA

OPSOMMING

'n Hadiobeheerde vliegtuig en kamerasistiem is gebruik om vertikale valskeur infrarooi fotos van sitrusboorde te neem. Die resultate was vergelykbaar met die van konvensionele lugfotografie en ook geskik vir navorsingsdoeleindes. Die tegniek mag voordelig aangewend word om op-names van wortelvrot en ander siektes by avokados te maak.

SUMMARY

A radio controlled aircraft and camera system was used to take vertical false colour infra red photographs of citrus orchards. The results were comparable to conventional methods of aerial photography and proved suitable for research purposes. The technique may be applied for surveys of root rot and other diseases of avocados.

INTRODUCTION

A knowledge of the extent and distribution of any disease is a prerequisite for the successful control thereof. Orchard and field inspections are laborious, time consuming and prone to subjective observations. Aerial surveys are objective and the information is permanent, with no dependence on memory or sketches.

Taubenhaus *et al.*, (1929) was one of the first to utilize aerial photography to survey the extent of root diseases. He used black and white panchromatic film in a hand held camera, equipped with a yellow filter, to monitor the extent of cotton root rot infestation. Following the establishment of aerial photography as a technique, all combinations of cameras, films and filters were tried. Black and white infra red film was demonstrated as a useful technique by Bawden (1933).

The most significant development in the field of agricultural aerial photography was the development of false colour infra red film by Kodak during World War Two, (Toler *et al.*, 1981). Colwell (1956) employed this type of film for surveying a variety of diseases in agriculture and forestry. Brodrick *et al.*, (1971) compared false colour infra red aerial photography with multispectral aerial photography as detectors of *Phytophthora* root rot in avocado orchards. They found the multispectral technique more reliable than the false colour technique. However, the cost and complexity of the multispectral technique have prevented its further use in agriculture.

The principle of false colour infra red photography is based on the sensitivity of the film emulsion to light with a wavelength of 300 to 900 nm. By fitting a suitable filter to the camera lens only the 500 to 900 nm spectrum is allowed to reach the film emulsion. These longer wavelengths are not absorbed by green plant material to any significant extent. More than 80 percent of the light rays in the 500 to 900 nm spectrum is reflected by normal turgid leaf tissue. When a plant is subjected to a moisture stress, partial plasmolysis of the mesophyll cells results in a dramatic decrease of light reflectance. This loss of leaf reflectance results in a colour shift from a red (normal) to a blue (stressed) image on the transparency (Toler *et al.*, 1981). Since any root malfunction is reflected as a moisture stress in the above ground parts of plants before the appearance of other symptoms, false colour infra red photography is extremely useful for the early detection of root diseases.

MATERIALS AND METHODS

In this study Kodak 35 mm Ektachrome Infrared transparency material was used in conjunction with a Canon AF35M automatic camera, fitted with a Kodak Wratten No. 12 filter. A radio controlled servo was mounted on the camera to operate the shutter release (Fig 1). The camera unit was mounted in a purpose built radio controlled aircraft (2,5 m wing span and 4,5 kg mass), (Fig 2 and 3). The aircraft was flown at an altitude of ca 400 m in a straight line above target citrus orchards. One exposure was made every five seconds, giving a frame to frame overlap.

RESULTS

The combination of film, camera and carrier employed in this survey produced results comparable with other methods of aerial false colour infra red photography. Normal healthy trees exhibited a red colour. Light stress resulted in a pink colouration shifting to mauve and eventually to blue with increasing stress.

DISCUSSION

The reported method proved to be very useful for orchard surveys as a result of the high resolution obtained by the relatively low operational altitude, making it highly suitable for research purposes. Furthermore, this method proved to be far cheaper and flexible compared to commercial aerial photography. However the limited area covered (ca 12 ha) by each exposure makes this method unsuitable for large scale surveys of extended areas.

In a recent tree census infra red photography was used extensively. Trees with root rot could be identified with considerable ease in the survey. There is no reason why this simple technique could not be used in future aerial surveys.

REFERENCES

BAWDEN, FC, 1933. Infra-red photography and plant virus diseases. *Nature* 132:

168.

BRODRICK, HT, GILBERTSON, B & KREITZER, MH, 1971. Advances in aerial photography. *SA Citrus Jnl* 449: 9 – 13.

COLWELL, RN, 1956. Determining the prevalence of certain cereal crop diseases by means of aerial photography. *Hilgardia* 26: No. 5.

TAUBENHAUS, JJ, EZEKIEL, WN & NEBLETTE, CB, 1929. Airplane photography in the study of cotton root rot. *Phytopath* 19: 1025 - 1029.

TOLER, RW, SMITH, BD & HARLAN, JC, 1981. Use of aerial colour infrared photography to evaluate crop disease. *Plant Disease* 65: 24 - 31.