USE OF AERIAL PHOTOGRAPHY IN DETECTING STEM NEMATODE INFESTATIONS IN LUCERNE

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Summary

Aerial photography using false-colour infra-red film was used to survey a 450 km² area of North Otago where stem nematode (*Ditylenchus dipsaci*) infestation of lucerne (*Medicago sativa*) was known to be severe. Results showed that this technique was satisfactory to assess areas and spread of infestation within known infested fields. However, it was unsatisfactory in a general survey because of an inability to distinguish consistently lucerne from pasture or nematode infestation within lucerne fields from rocky ridges, sheep camps, or drowned-out areas. Cost of FCIR aerial photography from 3050 m was estimated at approximately 70 cents/km².

INTRODUCTION

Accurately quantifying disease or pest incidence is difficult and time-consuming but advances in aerial photography have promised improvement (Cochrane 1972). Stem nematode (*Ditylenchus dipsaci*) is a serious pest of lucerne (*Medicago sativa*) in North Otago, South Canterbury and some parts of North Canterbury. The extent of nematode infestation seemed an ideal subject for aerial estimation because preliminary aerial photography of infested lucerne stands adjacent to Lincoln clearly showed the extent of the infestation.

MATERIALS AND METHODS

A Hasselblad EL/M camera with 70 mm magazines and a Carl Zeiss F 3.5 100 mm lens was mounted on a gimballed mount over a hatch in a Cessna 172 aircraft to allow for drift and flying attitude.

Flying at a constant altitude of 3050 m above ground each photographic image covers a square of side of approximately 1.5 km, an area of about 225 ha.

Kodak type 2443 false colour infra-red (FCIR) film was used in conjunction with a number 15 yellow filter and a number 10 magenta colour correction filter on the camera. This yellow filter cuts out the blue visible light up to 515 nanometers (nm) and the magenta filter is used to correct the blue colour cast of the film caused by certain topographic conditions and the method of film processing.

FCIR is sensitive to both tonal differences and colour changes while black and white infra-red (BWIR) is sensitive only to tonal differences. The sensitivity of FCIR extends into the infra-red region of the spectrum, up to 900 nm whereas colour film reaches only 690-700 nm. Therefore FCIR is more sensitive to variation in the plant canopy because of its greater sensitivity to infra-red reflectance. Healthy plants reflect far more infra-red than do diseased plants of the same species.

The film was processed in a Computer Lab punch card precision processor following the film manufacturer's instructions. Modification of the development can, however, be used to highlight special features.

Proc. 29th N.Z. Weed and Pest Control Conf.

Lucerne

Although this is a reversal film (i.e. as used for slides) it was printed as a negative film, which makes the colours more normal. This also enhances the tonal differences in the plant canopy and means that lucerne crops which appear as tones of red to magenta on the film, depending on the amount of infra-red reflectance, become blue to yellow-green on the print. Bare soil which is grey to white on the negative becomes reddish brown on the print.

The survey covered an area of 450 km² of North Otago bounded by Georgetown, Ngapara and Otiake where nematode infestation is known to be severe. It was flown on October 7th, 1975, the most suitable time of the year, as the stunting effect of stem nematode is most marked in lucerne before the first spring cut. Flying and light conditions were excellent and the photography was completed between 11.45 a.m. and 1 p.m. when the sun was at or near its maximum elevation.

DISCUSSION

In fields known to be infested aerial photography has application for accurate measurement of the infested areas, and for monitoring the rate of spread of nematode from year to year. At 3050 m the lens can resolve areas as small as 1 m² but with the present level of technology, the technique has shortcomings in estimating overall nematode incidence. Often it is difficult to distinguish lucerne from pasture, or nematode patches from rocky ridges, sheep camps, and drowned-out areas.

Confusion between pasture and lucerne arose from variation originating from the film, surface lighting, land contour, and print processing. This caused significant variation between prints of the same area. This confusion could have been accentuated by variation in pasture composition, stage of growth or grazing management. An additional photographic flight using BWIR film at lower cost than FCIR (Table 1) in late summer when lucerne would have been the only crop with a full, green canopy could probably have differentiated between lucerne and pasture. Although this film is less expensive it was felt that the extra expense was not justified (see Table 1).

TABLE 1: COST OF AERIAL PHOTOGRAPHY PER 100 ft ROLL OF FILM ASSUMING FLYING IS AT A HEIGHT OF 3050 m

	False Colour Infra-Red or Normal Colour Negatives	Black and White Infra-Red
Film	\$120	\$20
Developing	100	10
Paper	120	50
Chemicals	100	10
Total	\$440	\$90
Approximate cost for film	50c/km ²	10c/km ²

Plane hire currently costs \$36 per hour and it is reasonable to expose 90 images per hour i.e. 40c/exposure or 18c/km². There is the additional variable cost of getting the plane to where the photographs are to be taken.

In lucerne fields the major contrast is between diminished ground cover due to the stunting of nematode-infested plants and the healthy lucerne canopy. Therefore in fields that have areas of diminished ground cover due to rocky ridges, sheep camps, or flooding, confusion between these and patches of nematode infestation can occur.

Lucerne

Aerial surveys always need some confirmation on the ground. Ideally this should take place close to the time of photography because delay makes confirmation more difficult and time-consuming. In the present case two weeks elapsed between the flight and the ground survey. In a period of rapid growth this made the prints difficult to interpret accurately because of growth or grazing that had occurred in the interim.

It is concluded that aerial photography as a tool to assist research in stem nematode infestation in lucerne is likely to be most valuable in assessing areas and rate of spread of infestation within stands known to be infested rather than in discovering new areas of infestation. Future improvements or refinements in photographic technology and changes in cost structure may alter this conclusion.

REFERENCES

- Cochrane, G.R., 1972. Colour infra-red photography, crop vigour and pest and disease detection. *Proc. 25th N.Z. Weed and Pest Control Conf.* 174-179.