AERIAL PHOTOGRAPHY – AN AID IN SURVEYING FOR DAMAGE BY ROOT-LESION NEMATODE IN FLUE-CURED TOBACCO

C.F. Marks[2] J.M. Elliot,[2] J.R. Rainforth,[3] M.C. Watson:' and B. Back[2]

Abstract

Aerial infrared photography was assessed as a technique for detecting root-lesion nematode (Pratylenchus penetrans) damage in fiue-cured tobacco by comparing photographic interpretation with ground observations, and by determining root-lesion nematode population densities and chemical analyses of soil samples. A total of 130 fields, representing about 525 ha of flue-cured tobacco, were surveyed. It was not possible to differentiate, from the aerial photographs, areas of nematode damage from those of poor growth due to other factors. However, aerial photography could be useful as a supplementary technique for surveys of nematode damage. Only 3%of the samples showed root-lesion nematode population densities greater than 2200/kg of soil; and at lower densities there was no apparent relationship between poor growth and numbers of nematodes in the soil.

Résumé

On a évalué les photographies aériennes infrarouges comme technique de detection des dégâts causes par le nematode radicicole (Pratylenchus penetrans) dans le tabac jaune, par comparaison de l'interpretation photographique avec les observations au sol et par determination de la densité des populations de nématodes et des analyses chimiques d'échantillons de sol. On a ainsi prospect& un total de 130 champs comptant environ 525 ha de tabac jaune. A partir des photographies aériennes, il a été impossible de différencier les zones de dégâts dûs aux nematodes de celles de mauvaise croissance attribualbe à d'autres facteurs. Toutefois, la photographie aérienne s'est révélée utile comme technique supplémentaire d'évaluation des dégâts causes par les nematodes. Seulement 3% des échantillons ont donne des densités de population de nematodes supérieures à 2,200 organismes/kg de sol et, à des densités plus faibles, il ne semblait y avoir aucun rapport entre la mauvaise croissance du tabac et le nombre de nematodes dans le sol.

Aerial infrared photography is useful for detecting plant damage caused by a number of organisms (Brenchley, 1968). Recently, aerial photography has been used in Ontario to detect bacterial blight of field beans (Wallen & Jackson, 1971) and verticillium wilt of potatoes (Busch et al. 1970). In England, Dunning and Cooke (1967) used aerial photography in studies on the distribution of the docking disorder of sugar beets, often caused by nematodes (Trichodorus spp. or Longidorus spp.). Heald et al. (1972) also found that differences in growth of cotton in fumigated and non-fumigated plots infested with Rotylenchulus reniformis Linford and Oliveira could be readily detected by aerial infrared photography.

Agriculture Canada, Research Stations at [1]Vineland Station, and [2]Delhi, Ontario; and Ontario Ministry of Agriculture and Food, [3]Vineland Station and [1]Delhi, Ontario.

The root-lesion nematode, Pratylenchus penetrans (Cobb) Fillip & Stek. 1941, on flue-cured tobacco is the most serious nematode problem in Ontario. Olthof and Hopper (1973) have shown the general distribution of nematodes in the flue-cured tobacco growing area of southwestern Ontario. The objective of this work was to determine whether aerial infrared photography could assist in locating nematode affected areas of flue-cured tobacco. Aerial photographs, ground observations, nematode population densities, and chemical analyses of soil samples were compared.

Materials and methods

Kodak Aerochrome Infrared Film 2443 was used in conjunction with a Pan 520 filter on a wild Heerbrugg RC 10 camera with a focal length of 88 mm and an exposure of F. 5.6 at 1/200 second. On July 29, 1972, about 6

Table 1. Relationship between numbers of root-lesion nematodes in soil samples, growth condition of flue-cured tobacco, and some chemical factors in the soil

No. of nematodes/sample		Samples/range			Concentration (ppm) of		
Range	Avg	Total no.	% from areas of poor growth	pH	P	K	Mg
0	0	46	62	6.5	113	240	66
10-99	35	198	59	5.6	101	220	69
100-499	220	66	49	5.4	107	226	55
500-999	670	15	27	5.2	99	227	55
1000-	2200	11	89	5.1	92	231	52

weeks after transplanting, when root-lesion nematode damage is usually most obvious, photographs were taken at 1220 m and 3810 m above ground level. Only the photographs taken at 1220 m were used in this survey. An area of 3.2 km x 16.1 km in North Walsingham township, Norfolk Country, Ontario, was photographed. This area was chosen because it had the greatest proportion of flue-cured tobacco acreage in the region.

Initially, type of crop and areas of poor growth were identified on the 9 x 9 inch (23 cm x 23 cm) color transparencies with the assistance of the Department of Engineering, University of Guelph. The areas to be checked for nematodes, however, were delineated by locating light-toned areas on black and white prints made from the color transparencies. Soil samples were taken in those areas of poor growth that were not due to obvious differences in topography. Soil samples, each consisting of about 20 cores of soil 2.5 cm in diam and 20 cm deep, were taken August 8-11 near the roots of plants; samples were collected from areas of poor growth and good growth in each field selected. Nematodes were extracted from 50 g of soil from each sample by the modified Baerman pan technique (Townshend 1963) for 1 week. The pH and the concentration of P, K, and Mg for each sample were determined by the Department of Land Resource Science, University of Guelph.

Results

A total of 336 soil samples from 130 fields (about 525 ha) of flue-cured tobacco were collected; 56% of these samples represented areas of poor growth. Pooling of the data from all of the samples showed no differences ($P>0.05$) between good and poor areas in numbers of root-lesion nematodes and concentrations of P, K, and Mg in the soil. However, when numbers of root-lesion nematodes in the soil were grouped as in Table 1, there was a high inverse correlation between numbers of nematodes and soil pH ($r = -0.98$). It was also found that growth in about 90% of the areas with nematode populations above 2200/kg of soil (3X of the samples) was rated as poor. There appeared to be no relationship between nematode numbers and growth of the plants at nematode population densities below 2200/kg of soil.

Discussion

The above-ground symptoms of root-lesion nematode damage to tobacco are indistinct and vary little from symptoms produced by various other organisms and soil factors. Therefore, from aerial photographs, it was not possible to differentiate between areas of nematode damage and areas of poor growth due to other factors. The aerial photographs did assist in the ground observations by permitting ground observers to identify and locate the tobacco fields and areas of poor growth within fields, thus minimizing the survey time required. A further saving of time may be possible by using aerial photographs in conjunction with topographic and soil survey maps to eliminate areas of poor growth due to drainage problems. Indeed, this technique appears to have potential as a tool in surveys of nematode damage in other crops and further developmental work is warranted.

To assess the technique of aerial photography for detecting root-lesion nematode damage in flue-cured tobacco it is necessary to correlate damage observed in the photographs to numbers of nematodes in the soil. In the present study this was difficult. First, approximately 85% of the acreage was fumigated and thus nematode numbers, and subsequently nematode damage, were low. Second, the samples were collected in early August when the numbers of root-lesion nematodes in the soil have usually declined to a minimum (Olthof 1971). These two factors, no doubt, accounted largely for the generally low numbers of nematodes in the soil in the fields surveyed. A third factor

in this survey was the general occurrence of areas of poor growth due to replanting because of the frost damage which occurred on June 11, 1972. In a normal growing season aerial photographs and soil samples could be taken at an earlier date when better correlations between damage and nematode numbers in the soil might be expected.

The inverse relationship between pH and numbers of root-lesion nematodes in the soil (Table 1) agrees with results of Kincaid and Gaumann (1957) who showed an inverse relationship between degree of coarse root of tobacco (caused by Pratylenchus sp.) and pH. Willies (1972) also showed in a greenhouse experiment that between pH 4.4 and 7.3 the greatest reproduction of P. penetrans and decrease in forage yields occurred at 5.2.

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