CONTROL OF THE BEET YELLOWS DISEASE VECTOR *MYZUS PERSICAE* AND THE RESULTANT EFFECTS ON YIELD IN CANTERBURY BEET CROPS

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SUMMARY

The numbers of virus vector *Myzus persicae* found in the beet crop varied widely from season to season but the aphids always disappeared during the third week in December. In the 1981-82 programme, a number of insecticides were tested for their ability to protect the crop against beet-yellows vectors. Synthetic pyrethroid, fenvalerate, was as effective applied monthly as weekly in preventing virus-related yield losses. This is consistent with overseas findings that synthetic pyrethroids may disrupt aphid virus transmission. The systemic insecticide phorate was ineffective.

INTRODUCTION

Since the spring of 1979 a study has been conducted examining beet production for ethanol-based fuel. During this work it has become apparent that aphid-borne virus yellows disease is the most serious insect-related threat to the crop (Pearson and Goldson 1980). Accordingly, work has been orientated towards further investigation of the bionomics of the virus vector (mainly the green peach aphid, *Myzus persicae* the effect of virus yellows on yield and the feasibility of using insecticide to prevent disease establishment.

This report is an interim analysis of some of the results obtained.

METHOD

All trials were conducted on border-dyked Templeton silt loam at the Templeton Agricultural Research Station. The experimental design used in the 1979-80 season has been described elsewhere (Pearson and Goldson 1980). Based on the findings of the 1979-80 season the present trial (1981-82), was conducted on the sugar beet cultivar, Monoire, sown on 17.9.81 at 133,000 seeds/ha. Nine insecticidal treatments, designed to test their relative effectiveness in preventing disease spread, were used. For the purposes of this interim discussion only five treatments are reported (see Table 1). Each treatment was replicated eight times in a randomised block design on 16 x 8 m plots. Fenvalerate was selected to establish whether such a synthetic pyrethroid exhibits any potentially useful repellent qualities.

Aphid flights were monitored using four wind-vane traps installed at a height of 600 mm on the levees within the beet crop. All traps were cleared and the contents examined weekly. Also, at weekly intervals the leaves on 3-10 plants/plot were examined and the total leaves/plant, aphid numbers and frequency of aphid morphs recorded. Harvests were taken on 9.2.82 and 29.3.82.

RESULTS AND DISCUSSION

In the 1979-80 season a maximum aphid density of 5.4/plant was observed. These insects transmitted sufficient virus disease to produce at least a 19% loss in potential wet root yield; DSIR research has since confirmed that the virus responsible is closely linked to beet western yellows virus (BWYV) (J.W. Ashby, pers comm). During the 1980-81 summer, aphid numbers never peaked beyond 0.5/plant and had no measurable effect on yield. In 1981-82 the population peaked at 64/plant. This is about 240 times the level

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where British growers are advised to spray (British Sugar Corporation, pers comm). In all seasons the populations of aphids disappeared completely during the third week of December.

The high numbers of aphids in 1981-82 arose from primary infestation (i.e. winged immigrants) much greater than that usually measured in the U.K. (G.D. Heathcote pers comm; J.D. Mumford pers comm) and demanded weekly applications of fenvalerate (Treatment 5).

Fig. 1: Weekly counts of aphids/plant, 1981.

Figure 1 summarises the aphid densities under the treatments. Only treatment 3 effectively controlled aphids. The systemic insecticide, phorate, appeared to have little effect.

Table 1 presents the yields derived from the treatments at two harvest dates. The maximum yield was obtained from Treatment 3 which kept the aphid population at less than 1/plant compared with 64/plant in the untreated (Fig. 1). Conversely, the yield from the phorate plots indicates little protection through the use of this material. The ineffectiveness of slow acting systemic insecticides in preventing the establishment of yellows disease when there is a high level of primary attack is well known (e.g. Bawden 1964). This is due to the need for fast knock-down or repellancy to prevent virus inoculation which can occur in as little as 10 minutes (Duffus 1973). The use of systemic insecticides overseas is restricted mainly to preventing the spread of disease from loci within the crop arising from established aphid colonies (i.e. secondary infection). When levels of primary infestation are as high as those observed in this trial, this role becomes insignificant (G.D. Heathcote pers comm).

Figure 1 shows Treatment 3 with its methamidophos component to control the aphid effectively when applied weekly. Such control is reflected in the high yields indicated in Table 1.

Further examination of Table 1 shows that Treatment 4 (fenvalerate applied monthly) resulted in high yields considering the numbers of aphids that persisted in the crop (Fig. 1). Other treatments that permitted similar numbers of aphids to survive, showed higher levels of virus and sustained greater losses in yield (Goldson and Pearson unpublished). Weekly applications of the same material made no significant difference to the yield (Table 1, Treatment 5), although aphid numbers were markedly reduced (Fig. 1).

TABLE 1: Root fresh weight of sugar beet.

Treatment	Yield (t/ha)	
	9.2.82	29.3.82
1 untreated	37 c	70 b
2 phorate*	45 b	71 b
3 phorate* + methamidophos (1.5 kg/ha) and fenvalerate (105 g/ha) applied weekly	55 a	88 a
4 phorate* + fenvalerate (105 g/ha) monthly	49 ab	78 b
5 fenvalerate (105 g/ha) when aphid density > 0.5/plant	47 b	76 b

* Phorate drilled with seed at 0.6 kg/ha

Highwood (1979) commented on a similar effect and indicated synthetic pyrethroids may have value as a means of protection against aphid-borne virus disease. However, he derived his conclusions from aphid densities and disease incidence that were only a fraction of those observed in this trial. Gibson *et al* (1982) found evidence of synthetic pyrethroid induced disruption of beet virus transmission by aphids. They suggested that this may relate to the partial paralysis that results from sub-lethal doses of synthetic pyrethroid. A more detailed analysis of the effects of fenvalerate on *M. persicae* populations and their transmission of BMV in Canterbury is currently in preparation (Goldson and Pearson).

Assuming Treatment 3 afforded almost complete protection against virus attack 32.4% of total wet root yield had been lost to virus attack at first harvest compared to 21.2% at the second harvest. This suggests that there may be some compensation for losses later in the season.

Virus disease in sugar beet in Canterbury will be a problem should the crop be grown extensively. However, the highly variable levels of aphids and hence, virus disease from one season to the next presents the opportunity for the development of models using weather data to predict outbreaks. These would allow timely prophylactic action to be taken. Such work is well advanced overseas (e.g. Watson *et al* 1975). Synthetic pyrethroids show promise as 'aphid disrupters' and the well-defined aphid season observed over the last 3 years, augurs well for the development of economically acceptable virus-vector control in beet.

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