BARLEY YELLOW DWARF VIRUS AND APHID VECTORS IN CANTERBURY, 1983-85

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SUMMARY

An outbreak of barley yellow dwarf virus (BYDV) in mid-Canterbury cereals in 1985-86 was related to two factors involving the main vectors — the cereal aphid (*Rhopalosiphum padi*) and the rose-grain aphid (*Metopolophium dirhodum*). Numbers of winged vectors in suction trap catches and on newly-emerged cereals were greater in June-July 1985 than in previous years. Sources of BYDV in winter cereals at the time of vector migration to spring barley were more abundant in October-November 1985 than in previous years.

Spring barley cultivars Fleet, Mata and Magnum were less susceptible to BYDV than cv. Triumph.

INTRODUCTION

Barley yellow dwarf virus (BYDV) was reported as a serious disease of Canterbury cereals in 1960-63 (Smith and Wright 1964). Variation in disease severity between years was related to variation in numbers of winged cereal aphids (*Rhopalosiphum padi*) (CA) trapped in autumn and spring (Lowe 1969). Vectors of BYDV include CA, the corn leaf aphid (*Rhopalosiphum maidis*), the rose-grain aphid (*Metopolophium dirhodum*) (RGA) (Gill 1967) and the blackberry-cereal aphid (*Sitobion fragariae*) (Guy *et al* 1986), all of which occur in Canterbury (Farrell unpublished).

Little BYDV had been observed in Canterbury in recent years, until an outbreak of the disease in the 1985-86 season. This paper relates data on vector aphid abundance to BYDV occurrence in 1983-85.

METHODS

BYDV incidence was noted during surveys on cereals in mid-Canterbury in winter and spring 1983-85, and in plots of cereals at the Lincoln DSIR research farm during the same period. BYDV infection in spring barley was scored on an arbitrary scale of 0-9 in December 1985. Steps of the scale corresponded to approximately 0, 0.1, 1, 5, 10, 20, 40, 60, 80 and 100% infection. A total of 71 spring barley crops in mid-Canterbury were scored at the flag leaf-flowering stages. Three cultivar trials with three or four replicates of 18-50 m^2 plots at Templeton (1) and Lincoln (2) were scored at the boot stage.

BYDV transmission by RGA was tested using groups of five wingless adults collected from infected oats in a field crop (December 1982) and in the glasshouse (August 1983). Each group was placed on a young (3 leaf) healthy plant of Coast Black oats (*Avena byzantica*) for 24 h. After removal of the aphids, test plants were held in an aphid-free glasshouse for 25 days before recording BYDV symptoms.

Flights of winged aphids were monitored with a Johnson-Taylor 30 cm diameter enclosed-cone suction trap (Johnson and Taylor 1955), with aperture 7.5 m above ground, at the Lincoln DSIR research farm. Winged aphids on winter cereals in the one-three leaf stage were collected and identified during surveys by 10 observer minutes/site. Between 20 and 30 crops in the Lincoln area were surveyed in July each year. Further surveys of winter cereals at tillering — two node stages were undertaken in late September and early October. Locality and inspection time/site varied between years, so spring collections of winged aphids could not be compared between years. Sites where winged fourth stage nymphs were found were excluded from the data, so that winged aphids recorded could be regarded as immigrants.

RESULTS

BYDV

BYDV were rare in mid-Canterbury cereals during 1983 and 1984. In June-July 1985, patches of BYDV-like symptoms were found in winter barley at Winchmore and Prebbleton, and were confined as BYDV by enzyme-linked immunosorbent assay (ELISA) (J. Fletcher pers comm). Widespread BYDV symptoms were seen in winter barley in the Lincoln area during late winter and spring, at a low (< 1%) rate of plant infection. BYDV was locally severe at Lincoln, where infection had increased to *c.* 30% in winter barley and *c.* 80% in spring barley by late November. BYDV infection in winter wheat was slight throughout the area. Surveys of 71 spring barley crops across mid-Canterbury in December showed a mean BYDV score of 1.6, equivalent to < 1% infection. In the spring barley cultivar trials, BYDV was less severe in cultivars Fleet, Mata and Magnum than in Triumph (Table 1).

TABLE 1: BYDV scores in spring barley cultivars: December 1985.

Cultivar	Score on scale 0-9†		
	Trial 1	Trial 2	Trial 3
Triumph	7.5 a*	8.0 a	6.0 a
Illia	—	—	7.0 a
Gwylan	7.1 a	—	—
Magnum	—	—	4.3 b
Mata	—	3.5 b	—
Fleet	3.3 b	—	—

†Scores equivalent to approximate incidence of infected plants as follows: 3 = 5%, 4 = 10%, 6 = 40%, 7 = 60%, 8 = 80%.
*differing letters indicate significant ($P < 0.05$) differences in cultivar mean scores.

Aphids

Table 2 shows selected monthly catches of RGA and CA winged adults in the Lincoln suction trap, together with survey records of winged adults collected from 20 sites in July. Four corn leaf aphids and three blackberry-cereal aphids were also trapped in the 15-month period, and a single specimen of each was collected in the survey in July 1985.

TABLE 2: Monthly winged aphid catches : trap and survey.

Source:	Species:	Rose-grain aphid			Cereal aphid			Total		
	Year:	83	84	85	83	84	85	83	84	85
Trap	June	0	2	15	3	2	40	3	4	55
	July	0	3	5	0	1	6	0	4	11
	August	5	1	2	2	1	3	7	2	5
	September	5	1	2	2	1	9	7	2	11
	October	62	56	49	38	16	77	100	72	126
Survey n/20 sites	July	0	6	57	0	5	11	0	11	68

Trap catches of RGA and CA in June-July increased from 3 in 1983 to 66 in 1985. Survey collections of these species in July, when all winter cereals had emerged, also increased between 1983 (total 0) and 1985 (total 68). Trap catches in September-October were similar between years, with the exception of a low catch of CA in 1984. Survey data for these months (Table 3) could not be compared between years for reasons given previously.

Relative numbers of trapped and field collected aphids differed between the two species. In July, ratios of RGA:CA were 8:7 in the trap, compared with 63:16 on

TABLE 3: Numbers of aphids in surveys* of winter cereals, 10 September to 15 October.

Year	1983	1984	1985	Total
Rose-grain aphid	90	54	38	182
Cereal aphid	0	8	2	10

*Total collected in 10 minute searches at 15 (1983), 109 (1984) and 20 (1985) sites

cereals. In September-October, trap catches of the two species were similar (175:143) but again RGA predominated in field collections (182:10) (Table 3). Similar collections of immigrant winged adults on spring cereals in November 1983-1984 also showed a predominance of RGA (48) over CA (1). Transmission tests using RGA from BYDV-infected oats gave 13 infections/33 tests (39%) from the field crop and 64 infections/80 tests (80%) from glasshouse oats.

DISCUSSION

Our data indicate that the positive relationship between trap catches of aphid vectors and BYDV intensity in winter cereals proposed by Lowe (1969) and Smith and Wright (1964) was valid for the BYDV situation in mid-Canterbury in 1983-85. Winter flights (June-July) of CA and RGA increased between 1983 and 1985 (Table 2) as did BYDV in winter cereals.

Information on the source of autumn flights is inconclusive. Smith and Wright (1964) considered ryegrass (*Lolium* spp.) to be the main source of viruliferous CA.

We rarely found CA or RGA on grasses inspected in autumn and winter (Stufkens and Farrell 1985). In contrast, of 50 greenfeed cereal crops (sown in March) inspected in June-July 1983-85, 90% were infested with RGA and 65% with CA at densities of 1-20 aphids/tiller, including winged nymphs. Greenfeed cereals were frequently infected with BYDV, particularly in 1985, and may form a significant source of BYDV infection in grain cereals.

BYDV infection of winter cereals in October-November was considerably greater in 1985 than in previous years, despite similar spring flights of CA and RGA in 1983 to 1985 (Table 2). A relatively high proportion of vectors among the aphids migrating from winter to spring cereals may account for the BYDV outbreak in spring cereals in 1985.

The relative importance of CA and RGA as vectors is uncertain. Our tests show that RGA is an effective vector of BYDV (39-80% transmission) in Canterbury, as it is in New South Wales (Waterhouse *et al* 1985). RGA predominated among winged immigrants on cereals in July (Table 2), in September-October (Table 3) and in November. However, CA can transmit BYDV during a 15 minute inoculation feed (Watson and Mulligan 1960), so that CA could infect cereals during brief visits.

BYDV comprises several strains differentiated by vector relationships (Gill 1967) and ELISA (Lister and Rochow 1979). Strains identified as RPV-like (transmitted only by CA) and PAV-like (transmitted by CA and RGA) have been detected in Canterbury cereals (J. Fletcher pers comm) and in New South Wales (Waterhouse *et al* 1985). Quantitative data on strain occurrence is needed to provide further information on BYDV epidemiology.

Overall the economic effect of BYDV in 1985 was slight in mid Canterbury. Locally severe BYDV (80% infection) in spring barley at Lincoln was associated with >40% reject grain passing an A6 (2.4 mm slot) screen (Stufkens and Farrell unpublished). Throughout the area, however, the BYDV infection rate was *c.* 1% or less. Losses due to BYDV may be reduced by the use of resistant cultivars, including the spring barley cultivars Fleet, Mata, and Magnum included in our survey (Table 1). Chemical control of BYDV with synthetic pyrethroids applied up to the early tillering stage in barley has been shown to be effective in Britain (Kendall *et al* 1985).

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