OBSERVATIONS ON CEREAL APHID IN WHEAT

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Summary

The high October, 1962, populations of aphids in autumn-sown wheat resulted from the multiplication of aphids which invaded the crops in late autumn and survived the winter. Because the potential for multiplication is so great, the *presence* of aphids in the crop in the autumn is likely to be as good a guide to the need for control measures, as *estimates* of numbers of aphids per plant at any particular time. Killing the aphids in May-sown wheat with dimethoate between mid-June and mid-September effectively reduced the secondary spread of barley yellow dwarf virus and increased yield and quality of grain. Grass surviving cultivation preparatory to drilling can be a source of virus-carrying aphids.

In 1954 Smith (1955) reported the presence of barley yellow dwarf virus in New Zealand and later showed the benefit from killing the aphid vector with insecticides before they gave extensive spread of the virus. Late in September, 1960, many wheat crops in Canterbury were found to be heavily infested with aphids, thus arousing the interest of the farming community. A field trial by Smith (Smith and Allen, 1962) supported the earlier findings, and the widespread occurrence of severely pinched grain in the subsequent harvest served to confirm the importance of this disease to the wheatgrower. Unfortunately the 1960 outbreak of aphids was not detected until about the peak of population growth. Thus the time of the initial invasion of the crop and the period of aphid build-up and virus spread within the crop, were not known.

Except for a few early autumn-sown and late spring-sown crops, wheat was free from aphids in 1961. In 1962 many winged cereal aphids (*Rhopalosiphum padi*) were present in early emerged autumn-sown wheat. Speculation was rife regarding the likelihood of their surviving severe winter conditions; the possibility of natural predators or grazing giving effective control; the density of aphid population necessary before control measures would give an economic return; whether more than one spray application would be required. Because of these uncertainties, intensive inspections of wheat fields were made in 1962 in Canterbury, North Otago and Central Otago. The results, together with data from field trials using dimethoate are presented here.

BIOLOGICAL NOTES

APHID INVASION

Invasion of crops is by the winged (alate) form of the aphid. Since they are slow flyers, air currents influence the direction and distance of flights. Once they have settled they hold fairly firmly on the plant but if shaken suddenly they may drop off. This character is a help in distinguishing them from other insects, particularly midges, which fly away when disturbed. Counts during May and June gave figures ranging from 0 to 12 winged aphids per square yard (per 150 to 200 seedlings in 7 in. drills) with 1 to 2 per square yard the most frequent count. Numbers were usually higher near the fence lines indicating either, that some flights originated from the fence-line grasses, or, in the case of live fences, that the shelter afforded made favourable conditions for alighting.

Photo: A. Underhill

Fig. 1: Cereal aphid colony on oat leaf. Note the white moulted skins.

No winged aphids were observed in wheat during July, or August. They were recorded again at Lincoln on September 13 (2 in 140 samples) and noted in subsequent crop inspections of wheat and barley at the level of 1 to 2 per square yard. By inference, spring invasion must in some cases have been much heavier than this, because some crops of spring wheat with up to 75% of plants showing primary virus infection were noted and in barley, counts of from 5 to 12 virus-yellowed plants per chain of row were made. One such wheat crop had evidently been invaded early in September from an adjacent crop of oats with extensive patches of barley yellow dwarf virus.

These autumn and spring invasion periods obtained by field observations corresponded closely with the aphid flight periods described by Lowe (1961, 1962) from aphid traps at Lincoln. Aphids were invariably found in crops which had emerged before the second week of June, while, other than for the exceptions noted below, no aphids were found until the end of September in crops which emerged after the middle of June. From the end of September onward this distinction between early- and late-sown crops tended to disappear and aphids could be found in most wheat crops. While flights out of the crop took place at about the time of ear emergence, examination of sprayed crops showed that re-invasion also occurred if the flag remained green, but that only small colonies established. The exceptions mentioned were two crops, one in North Canterbury and one in mid-Canterbury, where a considerable amount of ryegrass turf had survived cultivation and aphids had transferred from the grass to the wheat. This type of invasion could also be identified by the large number of plants showing primary virus symptoms and the fact that diseased plants frequently occurred in clumps grouped about a ryegrass plant.*

APHID ESTABLISHMENT AND SURVIVAL

When crops were examined in May and June, winged aphids, winged aphids in association with their wingless progeny, or colonies of wingless aphids were usually located on the undersides of the wheat leaves or in the centre of the plant. Colonies were most frequently of from one to four nymphs. Dead winged specimens were often found clinging to plants. During July and early August, aphids were difficult to locate. In most cases they had taken refuge on the plant at soil level, under protecting clods, in cracks beside the seedling, or between the coleoptile and first leaf sheath. The difficulty of finding aphids in winter no doubt accounts for reports of the sudden appearance of aphids in crops believed to be clean. In most instances there were only one or two large aphids on infested plants. In sheltered localities, however, such as on the north side of a gorse fence, small and large sized wingless aphids could be found on leaves well above soil level. This showed that multiplication occurs even in mid-winter.

Although the winter of 1962 was mild, observations made in different districts suggested that once aphids have established in a crop they can survive the extremes likely in our main wheat growing area. For example they survived the winter frosts at Cromwell and Hawea; frost and waterlogging at Waiau; and waterlogging at Lincoln where water lay on the surface for at least a day on several occasions.

Predators were noted. The first ladybirds were seen in wheat at Dunsandel on August 31 but were seen only occasionally later. In the second trial reported below no predators were noted during counts on September 13. On October 5, fourteen aphid lions and one lacewing were recorded at 10 of the 25 points counted in the controls. Based on these ten points this represented one predator

* Field diagnosis of infection was confirmed by isolation tests carried out by Dr H. C. Smith, Department of Scientific and Industrial Research, Lincoln, using virus-free aphids and healthy oat plants.

Photo: H. C. Smith

Fig. 2: Lincoln Trial. The dark strips are the controls. Sample strips being harvested at left.

per 93 aphids. No doubt many aphids had already been eaten but in view of the results of this and other trials it is evident that the predator population did not build up quickly enough in the spring of 1962 to reduce aphid populations and the consequent secondary phase of virus spread.

Control of aphids by grazing has been suggested. Six paddocks known to contain aphids and grazed at varying times between June and early September were kept under observation. In all but one (Oamaru) the population built up again to a level justifying spraying, indicating that grazing is not a reliable means of controlling aphids.

APHID CONTROL TRIALS

TRIAL 1—HALSWELL

Aotea wheat sown April 30, 1962, had two leaves at the time of the first spraying. Dimethoate, 3.6 oz (all rates given in active ingredient per acre) in 15 gallons of water was sprayed by landrover at the dates indicated in Table 1. (3.6 oz active ingredient is equal to 12 fl. oz of commercial formulation.) Yard square areas, five per plot, were counted for winged aphids in May. Ten sample tufts of from 4 to 6 tillers (approximately one plant) were counted from each plot in September.

TRIAL 2—LINCOLN

Hilgendorf (1961) wheat sown May 3, 1962, had reached the two-leaf stage by May 26, at which time counts of 0 to 11 winged aphids per square yard were obtained.

Three replicates with plots 46 ft wide by 15 chains long were sprayed by landrover at the dates indicated, with dimethoate, using 3.6 oz a.i. in 15 gallons of water per acre. Aphid counts are means of 10 random samples of 4 to 6 tillers per plant. Two strips 13 chains long by 8 ft 6 in. wide were harvested from each plot on January 3, 1963.

TABLE 1: APHID NUMBERS AND YIELDS OF WHEAT SPRAYED WITH DIMETHOATE ON DIFFERENT DATES (HALSWELL) IN 1962

Date of Spraying	Winged Aphids	Wingless Aphids	Yield	
	per sq. yd May 30	per tiller September 14	Bush/ac	As % control
May 23	0.1	2.7	41.5	109
June 16	0.7	0.01	55	144
May 23 and September 14	0.1	2.7	57.5	151
Control	1.1	6.9	38	100
May 23 — sheltered plot	0.0	6.3	29	76
May 23 — unsheltered plots	0.15	1.5	46	121

TABLE 2: APHID NUMBERS AND YIELD OF WHEAT SPRAYED WITH DIMETHOATE ON DIFFERENT DATES (LINCOLN) IN 1962

Treatment dates	Aphids per tiller		Yield		500 seed wt (g)
	Sept. 13	Oct. 5	Bushels dressed	As % of control	
July 18	0.17	0.12	63.8 A	135.5	4.80 A
August 30	0.00	0.01	63.5 A	134.8	4.29 A
July 18 and September 8	0.01	0.65	63.0 A	133.8	4.36 A
October 8	5.2	15.7	46.2 B	99.1	2.72 B
Control	5.2	15.7	47.1 B	100	2.84 B
C.V.			5.8%		13.5%

DISCUSSION OF HALSWELL AND LINCOLN TRIALS

At Halswell aphid invasion and establishment must have ceased by June 16 judging from yield response, while at Lincoln, though winged aphids were present from the middle of September, further build-up did not occur in plots freed of aphids before September 13. The Halswell figures show that a count representing about one winged aphid per 150 plants on May 30 increased to 25 aphids per plant by mid-September, and the Lincoln figures show a further threefold increase in numbers during the succeeding three weeks. The Halswell results from the sheltered plot showed that much smaller initial numbers can be a danger, especially in localities favourable to aphids. Here one aphid per 1,000 plants in May increased by September to about 6 per plant in the open and to 25 per plant (the same as control) on the north side of a gorse hedge.

These observations are reflected in the yield figures which were highest when the wheat was sprayed once between mid-June and mid-September. This period was after the autumn flights had ceased and before numbers exceeded a mean value of 5 to 7 per tiller. Spraying before flights had finished in the autumn (Halswell) gave some benefit but a second application was necessary. In this instance the extra expense could have been saved by delaying application to mid-June. The higher yield of control than of the "sheltered" sprayed plot is of interest in view of Dr H. C. Smith's evidence (pers. comm.) that early virus attack may protect the plant from the severe secondary symptoms.

The 500-seed weights illustrate the adverse effect of the virus on grain quality.

Despite the ultimate colonization of all plants within the control strips, the maximum lateral spread by wingless aphids into sprayed plots was 14 in., two drill widths (see Fig. 2). This implies that wingless aphids spread between plants only where they are in contact at ground level since the foliage touched across the rows from mid-July onwards. It indicates that narrow plots in the direction of drilling with 3 to 4 guard rows are adequate for this type of trial.

ACKNOWLEDGEMENTS

Thanks are due to Dr H. C. Smith, A. D. Lowe and Dr I. D. Blair for opportunities to discuss this problem and to D. Botting, Manager, Mixed Cropping Farm, Lincoln College, for great assistance in laying down and harvesting the Lincoln trial.

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