APHID CONTROL IN WHEAT AND BARLEY

(Wanganui, Rangitikei, Manawatu, Wairarapa)

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Summary

The results of attempts to control the cereal aphid (*Rhopalosiphum padi*) in spring-sown wheat for the past four seasons are reviewed. The effects of recurring flights, time of sowing, and varietal susceptibility on the effectiveness of control with organophosphates are discussed, while suggestions for future avenues of research are listed. The results achieved to date clearly demonstrate the economic significance of the cereal aphid. While the use of disulfoton granules at 16 oz a.i./acre with the seed and fertilizer, plus one to three sprayings with demeton-S-methyl at 3 oz a.i./acre have given the best control, spraying the more susceptible varieties with demeton-S-methyl offers better prospects of economic control.

INTRODUCTION

THE cereal aphid (*Rhopalosiphum padi*) in spring-sown wheat has been under close experimental study in the Wanganui, Rangitikei, Manawatu and Wairarapa districts for the past four seasons (1965-6, 1966-7, 1967-8 and 1968-9). In an earlier paper (Blackmore, 1967) results for the first two seasons were presented. In this paper results for all trials (a total of 29) are reviewed and summarized. *None of the sites was selected because aphids were a problem.* They were all chosen at the time of laying down the trials. For all trials aphid counts were made, while for certain key trials detailed plot counts were recorded and related to yield responses.

For all trials described, disulfoton and demeton-S-methyl are expressed in ounces of active ingredient (a.i.) per acre. For the first three seasons, disulfoton was in the form of 5% a.i. granules and in the past season in the form of 10% a.i. granules.

A. D. Lowe (pers. comm.) records two aphids of economic importance to cereal crops. The first is the cereal aphid (*Rhopalosiphum padi*) which tends to keep to the basal portions of the plant and the second is the grain aphid (*Macrosiphum miscanthi*) which in the early stages occurs well up the leaves, but migrates to the seed-heads when these appear. Damage by the cereal aphid is mainly through the transmission of barley yellow dwarf virus (BYDV) disease. However, it is probable that, with heavy infestations, plants suffer directly from the effects of the aphids feeding on them. Such effects, however, cannot be measured as they cannot be separated from virus effects. On the other hand, damage done by the grain aphid is due directly to the loss of sap flow to the head, as this aphid does not transmit disease. This article deals only with cereal aphid.

EFFECTIVENESS OF CONTROL METHODS

RECURRING FLIGHTS

The first aphid flights on lower country may occur as early as the end of September but may start considerably later in cold, wet springs. Once flights commence, they are recurring. This means that the growing crop is subjected to fresh flights throughout the remainder of its vegetative period. Because of this, effective control over a sufficiently long period to ensure worthwhile yield increases is difficult to achieve. All chemicals so far tried have had relatively short residual qualities. Because of this, experimental techniques involving repeat applications of organophosphates were employed to obtain control for an extended period. While this resulted in correspondingly higher yields, in no case has the control of aphids been complete. Techniques involving several operations are relatively expensive and therefore usually uneconomic. However, the method has been very valuable in gauging the seriousness of the problem. Hope, therefore, lies in the discovery of chemicals with longer residual effects.

TIME OF SOWING

Because first flights do not occur until the end of September at the earliest, early-sown wheat (July, August) is well advanced by this time and soon becomes unattractive to later flights. Early sowing where soil and climatic conditions allow is probably the most effective means of combating the problem.

VARIETAL SUSCEPTIBILITY

Trials have shown that considerable differences in susceptibility to BYDV occur between varieties. It is not clear whether this is due to actual differences in attractiveness of varieties to aphids or to differences in susceptibility to spread of the virus within the plant, or to both these factors. Trials have shown Raven and Triple Dirk to be more susceptible to BYDV than Gamenya.

ORGANOPHOSPHATES

To date, 24 trials dealing with the control of the cereal aphid were carried out over the three seasons 1965-6, 1966-7 and 1967-8 inclusive. Results are summarized below.

- The average yield increase from the use of organophosphates for all trials irrespective of variety was 7.0 bushels per acre.
- Sixteen ounces of disulfoton granules on their own applied with the seed and fertilizer at sowing, broadcast at the time of sowing, and broadcast at various stages on the established crop, have all given poor results. The first mentioned was, however, superior to the others. Four out of seven trials gave no increase in yield over control, although aphid numbers were substantially reduced. The other three trials gave 2.8 bu, 5.4 bu and 6.0 bu per acre increases, respectively. The 6.0 bu increase was only just payable.
- Two applications of 3 oz demeton-S-methyl spray gave an average per acre increase of 7.8 bu. However, both Raven and Triple Dirk gave greater increases than Gamenya. Results are presented in Table 1.

TABLE 1: YIELD INCREASES FROM TWO APPLICATIONS OF 3 OZ DEMETON-S-METHYL

<i>Variety</i>	<i>No. Trials</i>	<i>Ave. Increase (bu/acre)</i>	<i>Trials Showing Profitable Return</i>
Gamenya	8	4.8	3
Raven	4	8.3	3
Triple Dirk	4	11.1	3

Note: None of the sites for the above trials was selected for the presence of aphids. The areas were in fact chosen before the crop was sown. Had the sites been specifically selected because aphids appeared to be a problem, then there is little doubt that the increase from spraying would have been greater.

- Sixteen ounces of disulfoton granules followed by one to three sprayings with 3 oz demeton-S-methyl gave an average increase of 6.6 bu/acre. Individual varietal increases are given in Table 2.

TABLE 2: YIELD INCREASES FROM 16 OZ DISULFOTON GRANULES PLUS ONE TO THREE APPLICATIONS OF 3 OZ DEMETON-S-METHYL SPRAY

<i>Variety</i>	<i>No. of Trials</i>	<i>Ave. Increase (bu/acre)</i>
Gamenya	7	4.6
Raven	4	7.0
Triple Dirk	2	12.6

Although there were substantial increases in yields, only 4 out of 13 trials gave a profitable increase. The reason for this was the high cost of the treatments involved.

TRIAL RESULTS IN 1968-9 SEASON

Five trials were conducted during the past season.

WANGANUI AND RANGITIKEI TRIALS

There was one trial in each district in which three varieties of wheat (Gamenya, Raven, Gamut and an additional variety Opal in the case of the Wanganui trial) were compared with and without organophosphate treatment.

In both trials, 16 oz disulfoton was sown with the seed and fertilizer. Because aphids could not be detected in the Wanganui crop, spraying with demeton-S-methyl was omitted. In the Feilding trial, however, aphids were not seen in the crop until the wheat-heads were beginning to appear (Feeke's Scale 10/2 to 10/5). The trial was sprayed at this time. In neither trial was there any increase in yield resulting from organophosphate treatment.

MASTERTON TRIALS

Exceptionally wet spring weather delayed land preparations for wheat, with the result that many crops were not sown until October. Meanwhile,

with the higher prevailing temperatures, aphid numbers rapidly bred up to epidemic proportions in the surrounding grass areas and especially on roadsides and waste places where grasses ran to seed-head. Massive flights from these areas descended on neighbouring cereal crops. In some cases re-infestations occurred rapidly after spraying. This is the first experience in four years of experimenting in the Wanganui, Rangitikei, Manawatu and Wairarapa districts that such an epidemic has occurred.

This experience naturally raises the question: "Is there any point in attempting to control aphids in such circumstances?" Unfortunately, be- attempting to control aphids in such circumstances?" The following trials throw some light on this question.

Individual trial results are as follows:

(1) *Wheat Variety (Gamenya, Raven, Gamut) by Aphid Control Trial*

In this trial the use of 16 oz disulfoton with the seed and fertilizer plus one spraying with 3 oz demeton-S-methyl resulted in a 3.0 bu/acre increase (main effect). This increase was significant at the 1% level.

(2) *BYDV Control in Wheat Trial*

Because "granule plus spraying" treatments had given encouraging results previously, the present trial was designed to see whether the granule rate could be reduced with the object of cutting costs. Accordingly 4 oz, 8 oz and 16 oz disulfoton (equivalent to 2½ lb, 5 lb and 10 lb of 10% granules, respectively) were included along with two times of spraying with 3 oz demeton-S-methyl (times A and B, respectively). All combinations of these rates resulted in sixteen treatments.

Immediately prior to harvesting, all plots were individually assessed for the percentage of blackheads present. There appeared to be an obvious relationship between blackhead percentages and yields — i.e., the higher the percentage, the lower the yield.

Results are set out in Table 3.

TABLE 3: ESTIMATED PERCENTAGE BLACKHEADS IN RELATION TO TREATMENT

<i>Treatment</i>	<i>% Blackheads</i>
(1) Control	62.5
(2) 2½ lb granules	47.5
(3) 5 lb granules	32.5
(4) 10 lb granules	40.0
(5) Spray A	47.5
(6) Spray B	52.5
(7) Sprays A + B	42.5
(8) 2½ lb gran. + Spray A	40.0
(9) 2½ lb gran. + Spray B	47.5
(10) 2½ lb gran. + Sprays A + B	32.5
(11) 5 lb gran. + Spray A	32.5
(12) 5 lb gran. + Spray B	32.5
(13) 5 lb gran. + Spray A + B	25.0
(14) 10 lb gran. + Spray A	17.5
(15) 10 lb gran. + Spray B	20.0
(16) 10 lb gran. + Sprays A + B	7.5

The yields for this trial were unfortunately completely unreliable owing to a header fault. There was, however, an estimated 15 bu/acre increase for Treatment (16) compared with "control". This was considered to be a conservative difference by two independent assessors.

(3) *Aphid Control in Barley*

Immediately prior to sowing, 32 oz disulfoton was broadcast on to appropriate plots and harrowed in. Six weeks after sowing, the crop developed typical BYDV symptoms. At this stage both treated and untreated plots became heavily infested and it became obvious that the disulfoton was no longer having any effect. The plots which had previously received disulfoton were then sprayed with 3 oz demeton-S-methyl. The treated plots yielded a significant 7.0 bu/acre increase over control.

It would appear from the results of the above three trials that the use of organophosphates will definitely afford some protection to the crop under epidemic conditions. The question as to whether this can be done profitably remains unanswered.

FURTHER RESEARCH REQUIRED

Further progress in the search for better control of aphids is likely to come from the following:

APHID FLIGHT PATTERNS

While a good deal is already known about the flight patterns of aphids in the districts under study, a detailed investigation in relation to locality and altitude is overdue. Such an investigation may require a period of four or five years to complete. Included in this investigation should be a complementary study of the grain aphid.

FURTHER SPRAYING TRIALS REQUIRED

These are required because the spraying of crops has been the only method showing any economic advantage. It is also worth while investigating whether it is profitable to spray for late, heavy build-ups of aphids such as were experienced in the Wairarapa last season. Such build-ups could well be associated with the presence of the grain aphid.

TESTING NEW CHEMICALS

The chemicals available at present leave much to be desired. New chemicals with a longer residual life are urgently needed. These chemicals need not necessarily be organophosphates. The systemic sprays at present available appear to have a very short residual life in the plant. If their residual effects could be extended to, say, 14 to 21 days, the economics of spraying would be greatly altered. There is little doubt that some improvement in this direction will come in the future.

MORE RESISTANT VARIETIES

The breeding of greater resistance into varieties must be the constant aim and would, of course, be by far the best solution if it could be achieved, because it would have a "no cost" advantage to the farmer. As resistance is probably made up of two factors — the susceptibility of the plant to aphid attack and the plant's "internal" resistance to the actual

virus — the breeding of more resistant varieties would be no easy task. However, as has previously been pointed out, the variety Gamenya is considerably more resistant to BYDV than either Raven or Triple Dirk. The resistance of Gamenya is such that it places this variety in the category of being a doubtfully economic proposition to spray for aphids.

POSSIBLE NEW APPROACHES

A constant watch should be kept for possible new approaches to the problem of control. For instance, there is some evidence to suggest that crops treated with growth retardants may be less attractive to aphids. The value of spraying crops with materials which render them unattractive to aphids may be worth while investigating — *e.g.*, brassica oils.

CONCLUSIONS

(1) The knowledge gained from trials and observations in the Wanganui, Rangitikei, Manawatu and Wairarapa districts over the past four seasons has highlighted the very considerable importance of factors other than direct chemical control in coping with the damaging effects of the cereal aphid. The specific factors are time of sowing, altitude and varietal susceptibility. It is also important to know to what extent the grain aphid is affected by these same factors.

(2) Results to date indicate beyond all doubt that the cereal aphid is an important factor in substantially limiting potential wheat (and now barley) yields in the districts covered by these trials. The "discovery" of the grain aphid does, however, complicate the issue. The extent to which this aphid has affected yields in the past is not known. However, the use of organophosphates for cereal aphid control has, in the majority of cases, given significant increases in yield. It would appear, therefore, that the control of the latter aphid was the dominant factor in the responses obtained.

(3) The use of disulfoton granules alone (either with the seed and fertilizer or else broadcast on the crop) has in the main given disappointing results. However, the use of this material with late-sown crops could prove to be worth while. The sowing of granules with the seed and fertilizer poses several problems. Special attachments are required for the drill, the material is objectionable to handle, while the method is preventive and therefore involves considerable cost without the certainty that aphids will attack the crop.

The use of sprays (demeton-S-methyl) on the growing crop in addition to granules with the seed and fertilizer has given the greatest increases in yield, but this, too, has given uneconomic returns in most cases because of the high cost of the treatments. A reduction in the granule rate below 16 oz appears unlikely to give adequate control.

Spraying the crop once or twice, while giving smaller increases in yield, shows some economic promise for the more susceptible wheats.

(4) No chemical method has yet given a complete control of aphids and until this can be achieved the potential increase in yield due to the 'aphid-BYDV complex' cannot be measured. The economic loss involved is, in the writer's opinion, sufficiently high to make aphids affecting cereals (including the grain aphid) a number one problem.

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REFERENCE

Blackmore, L. W., 1967: *Proc. 20th N.Z. Weed & Pest Control Conf.*: 236.