THE INCIDENCE OF HESSIAN FLY AND OTHER PESTS IN NEW ZEALAND WHEAT CROPS

TONI M. WITHERS, MARION O. HARRIS and LORRAINE K. DAVIS

Dept. Plant Science, Massey University, Private Bag, Palmerston North.

ABSTRACT

Wheat fields in Canterbury, Manawatu and Rangitikei were examined for pests in November-December 1994. In Canterbury, tiller infestation by Hessian fly ranged from 0-28% (mean 6%). No Hessian fly pupae collected from an infested field in Canterbury were parasitised. Hessian fly was not found in the Rangitikei, and rarely in wheat from the Manawatu. In a Manawatu wheat field sampled again in January, tiller infestation had increased from 3% to 15%, and spread further into the field. Parasitism of Hessian flies from *Platygaster hiemalis* (Forbes) also increased during this time. Argentine stem weevil larvae were found in wheat in all areas and affected a greater percentage of tillers than Hessian fly. Mid-Canterbury (mean 35%) and Manawatu (mean 9%) were the most and least affected areas, respectively.

Keywords: wheat, Hessian fly, Argentine stem weevil, parasitism, infestation

INTRODUCTION

The Hessian fly (*Mayetiola destructor* Say) (Diptera: Cecidomyiidae) is one of the most important pests affecting wheat crops in the northern hemisphere. Following its introduction to New Zealand in the 1870's, major crop losses were attributed to Hessian fly outbreaks (Kirk 1894). In 1937 Morrison (1938) carried out a survey of the pests inhabiting wheat crops in the South Island, and attributed 1%, 3.8% and 9.2% stem breakage to Hessian fly in North, Mid and South Canterbury, respectively. There have been no surveys of wheat crop pests published since, although Blair and Morrison (1949) reported Hessian fly as prevalent throughout South Canterbury and North Otago. During this time resistant cultivars, cultural control methods, and parasitoids presumably helped reduce Hessian fly populations in wheat to acceptable levels. By 1971 Hessian fly was no longer considered to be a major pest (Anonymous 1971). Recently Hessian fly populations have become more noticeable primarily in prairie grass (*Bromus willdenowii*) (Prestidge and Van der Zijpp 1988). Farmers in South Canterbury (D. Penno pers. comm.) have also reported heavy infestations of Hessian fly. The purpose of this study was to compare infestations by Hessian fly in major wheat growing areas and to identify factors which may contribute to higher infestation levels. While sampling for Hessian fly we were also able to estimate infestation of other pests attacking wheat.

MATERIALS AND METHODS

Wheat fields in the districts of Canterbury (38 fields), Manawatu (16 fields) and Rangitikei (9 fields) were sampled on 22-24 November, 30 November-6 December, and 7 December 1994, respectively. In the survey, single plants were pulled from the ground approximately 10-20 m apart, starting 5-10 m from the field edge, until 20-30 plants had been collected. In the laboratory, plants were randomly chosen from the sample and 40 tillers were individually examined for pest damage. Hessian fly larvae and pupae were found by pulling back each leaf of the tiller to expose the crown of the plant. This process also revealed Argentine stem weevil (*Listronotus bonariensis* (Kuschel)) larvae. Wheat leafminer damage was identified by examining each leaf comprising the tiller. This sampling method was random relative to pest damage as

Proc. 48th N.Z. Plant Protection Conf. 1995: 165-169

infested plants could not be identified until the crown had been exposed. Damage was expressed as the percentage of tillers infested by each pest. Where there were physical differences in sowing or other conditions in fields, both parts were sampled separately. Hessian fly pupae (250) from one heavily infested field in Waimate were individually placed in glass vials on dampened cotton wool and held at 20-24 °C until Hessian flies or parasitoids emerged. After 3 months any unemerged pupae were dissected to check for parasitoids. Parasitoid species were identified from a key to parasitoids of Hessian fly in New Zealand provided by Dr R. Macfarlane.

The spatial distribution of Hessian fly in an infested wheat field (cv. Monod) in the Manawatu was determined by sampling plants along eight marked transects running W-E across the field (Fig. 2), first on December 14 and then on January 23. The first three samples were taken 1, 10 and 20 m from the western edge, with the remaining samples taken at intervals of 100 m across the rest of the field, the position of sampling sites marked by poles. Eight tillers from each sampling site were checked for Hessian fly larvae and pupae. Pupae (100 from the first and 150 from the second generation of Hessian fly) were held as described above to determine parasitism rates. The distribution of infestation between the generations within the field was then compared using a G-test (Sokal and Rohlf 1981).

RESULTS

Hessian fly larvae were rarely present in wheat fields sampled from the North Island. In the Rangitikei larvae were absent from all nine fields sampled. In the Manawatu, only two of the 16 fields sampled contained Hessian fly, with 3% and 8% of tillers infested. Hessian fly were more common in the South Island (61% of fields sampled). Of these infested fields, mean tiller infestation was 10%. The largest infestations recorded were 28% in Waimate, and 27% in Otaio, both in spring-sown crops. South Canterbury was the worst affected area in New Zealand (Fig. 1), with a mean tiller infestation rate per field of 8.3% (0-28%). All cultivars sampled were susceptible to attack. South Island Hessian fly pupae collected from Waimate revealed no parasitism. The first generation of Hessian fly pupae collected from the Manawatu

FIGURE 1: The mean pest infestation levels of wheat tillers taken from fields in areas of the North and South Islands of New Zealand in November/December 1994 (Vertical bars represent SEM).

revealed 5% parasitism from *Platygaster hiemalis*, after remaining unemerged pupae were dissected. A mean of five parasites (range = 4-6) were found per Hessian fly pupa. In the second generation of Hessian fly, parasitism from *P. hiemalis* had risen to 15% with an additional 1% parasitism from *Aprostocetus zosimus* (Walker).

The Manawatu field sampled twice in 1994-95 was situated directly east and north-east of two pastures which were sown in wheat in 1993-94 (Fig. 2). Winds during the 1994-95 spring-summer period were predominantly from the south-west; thus the 1993-94 wheat fields provided a likely source of infestation of spring-emerged flies. The first generation of Hessian fly infested 3% of tillers, mainly along the edges of the 1994-95 wheat field within 20 m of the western boundary (Fig. 2A). Two other wheat fields situated directly to the east of the infested field, were free of Hessian fly when sampled on December 6 1994. The second generation infested 15% of all tillers, now throughout the crop, but highest on the western and southern edges (Fig. 2B). Distributions of infestation were significantly different between generations ($G=1330$, $df=6$, $P<0.05$).

FIGURE 2: The change in distribution of Hessian fly infestation from (A) the first generation in December 1994, to (B) the second generation in January 1995, in a crop of wheat (cv. Monod) in Opiki, Manawatu.

Argentine stem weevil was found at high levels in both the North and South Island (Fig. 1). In the North Island, 80% of fields were infested. Within these fields mean tiller infestation rate of 13% (highest was 43% in a Rangitikei field). In the South Island, 76% of fields were infested, within these fields mean tiller infestation rate was 27% (highest was 83% infestation in Chertsey, Mid Canterbury). Mid Canterbury was the worst affected area (Fig. 1), with a mean tiller infestation rate of 35% (0-83%). Manawatu was the least affected area, with a mean infestation rate of 9% (0-20%). Leaf miners (unidentified) were also present in 52% of North Island fields (0-8% infestation) and in 24% of South Island fields (0-8% infestation) (Fig. 1).

DISCUSSION

Although the first major Hessian fly infestations were in the Rangitikei district, in 1888 (Kirk 1894), no Hessian flies were found in this area in December 1994. In the Manawatu, infestations were found occasionally but were quite localised. Infestation was widespread in the South Island, with severe localised infestations in the Southern Canterbury districts of Waimate and Willowbridge. Historically these districts have suffered occasional Hessian fly outbreaks (Blair and Morrison 1949), Morrison's 1938 survey found approximately a quarter of plants in four fields sampled in Willowbridge were severely infested with Hessian fly.

We were seldom able to ask farmers about crop rotations or pesticide treatments, and thus could not draw conclusions about their potential impact on Hessian fly populations. In most cases we identified cultivars and found no consistent relationship between cultivar and infestation levels. In one heavily infested field in Waimate, all 14 different cultivars and 48 advanced lines of wheat planted (Harris, unpub. data) were infested with Hessian fly. However, in one Willowbridge crop, plants were sampled separately from large areas within the field that were either healthy or stunted. Hessian fly was found in 5% of the healthy and 13% of the stunted tillers. This suggests some interaction between Hessian fly infestation and physiological stress on the plant.

Destruction of wheat stubble in the previous year may have a significant impact on Hessian fly populations. The only field found to be heavily infested with Hessian fly in the North Island was planted down-wind of two pasture fields that were planted to wheat in the 1993-94 season but not burnt-off after harvest. The straw in these fields had been cut and sold for mushroom mulch, leaving insufficient vegetation for adequate burn-off (a cultural control method for Hessian fly). It is likely these pastures provided a source of Hessian fly infestation for the sampled field. Hessian flies have been shown (Withers and Harris unpub. data) to be carried down-wind when initiating flight in winds above 0.9 m/s. After spring emergence of adults in pasture (most pasture plants are not hosts of Hessian fly), prevailing winds may have carried adults to the edges of this young wheat field. Sampling in this field again in January indicated that significant increases in infestation occurred over one generation of Hessian fly. During this time infestations also spread from the edges to the centre of the field.

Both parasitoid species identified from the North Island are specific to the Hessian fly and are thought to have been introduced to New Zealand in 1894 (Kirk 1898), with a shipment of Hessian fly pupae from the U.S.A. The parasitism rates obtained in the current study were consistent with those recorded previously by Macfarlane (1990) who found that spring generations of Hessian fly in the South Island were relatively free of parasitoids, with parasitism rates increasing over the summer months. *P. hiemalis* is the most common parasitoid of Hessian fly throughout New Zealand and commonly parasitises 5-38% of Hessian flies (Macfarlane 1990; Prestidge 1992). The pupae collected from the Manawatu in this study revealed that *P. hiemalis* was active in the spring in the North Island. Though it increased in abundance over the summer, it did not prevent increases in Hessian fly populations. *A. zosimus* has been recorded previously from both Lincoln and Hamilton (R. Prestidge unpub. data).

In 1938 Morrison stated that Hessian fly was of greater importance as a wheat pest than was Argentine stem weevil throughout the South Island. However our survey would indicate that in the early summer (the same time as Morrison surveyed), the opposite is now the case. Argentine stem weevil is a pest of numerous cereals and grasses in this country (Prestidge and Van der Zijpp 1988), and these results show it continues to affect wheat crops. Our survey indicated it is presently the major pest affecting wheat in North Island districts. However the relative importance of Argentine stem weevil and Hessian fly may alter as the biological control agent introduced to control Argentine stem weevil increases in number and distribution (Goldson *et al.* 1992). If the cultural control practise of burning-off wheat stubble is discontinued due to environmental pressure, Hessian fly may also increase in importance as a pest throughout the wheat growing regions of New Zealand.

ACKNOWLEDGEMENTS

United Wheatgrowers NZ Ltd for research funding; W. B. Griffin, and M. Cromey, Crop and Food Research Inst., Lincoln; D. Penno, G. Claridge, B. Short and other farmers who gave access to fields; Charlotte Madie for technical assistance. R. P. Macfarlane, Bussuniversal, aided with parasitoid identification.

REFERENCES

- Anonymous, 1971. Hessian fly, *Mayetiola destructor*. Pp. 1-3 In: Insects. N.Z. Dept. Agr. Report
- Blair, I.D. and Morrison, L., 1949. Wheat diseases and insect pests. *N.Z. D.S.I.R. Information Series* 3: 1-59.
- Goldson, S.L., McNeill, M.R., Phillips, C.B. and Profitt, J.R., 1992. Host specificity testing and suitability of the parasitoid *Microctonus hyperodae* (Hym.: Braconidae, Euphorinae) as a biological control agent of *Listronotus bonariensis* (Col.: Curculionidae) in New Zealand. *Entomophaga* 37: 483-498.
- Kirk, T.W., 1894. A brief history of the Hessian fly in New Zealand. *Dept. of Agr. Ann. Report* 2: 83-87.
- Kirk, T.W., 1898. Hessian fly *Cecidomyia destructor*. *Dept. of Agr. Ann. Report* 6: 171-174.
- Macfarlane, R.P., 1990. *Mayetiola destructor* (Say), Hessian fly (Diptera: Cecidomyiidae). Pp. 101-104 In: A Review of Biological Control of Invertebrate Pests and Weeds in New Zealand 1874 to 1987. P. J. Cameron, R. L. Hill, J. Bain and W. P. Thomas (Eds.); CAB International.
- Morrison, L., 1938. Surveys of the insect pests of wheat crops in Canterbury and North Otago during the summers of 1936-37 and 1937-38. *N.Z. J. Sci. and Tech.* 20A: 142-155.
- Prestidge, R.A., 1992. Population biology and parasitism of Hessian fly (*Mayetiola destructor*) (Diptera: Cecidomyiidae) on *Bromus willdenowii* in New Zealand. *N.Z. J. Agric. Res.* 35: 423-428.
- Prestidge, R.A. and Van der Zijpp, S.G., 1988. Survey of Argentine stem weevil and Hessian fly in the northern North Island. *Proc. 39th N.Z. Weed and Pest Control Conf.*: 118-120.
- Sokal, R.R. and Rohlf, F.J., 1981. Biometry. W.H. Freeman and Company, New York, 859 pp.