MONITORING *GRAPHANIA MUTANS* (NOCTUIDAE) IN APPLE ORCHARDS

G. M. BURNIP[1], D. M. SUCKLING[1], P. W. SHAW[2], V. WHITE[3], and J. T. S. WALKER[3]

[1]*HortResearch, P.O. Box 51, Lincoln*
[2]*HortResearch, Appleby Research Orchard, RD 1, Nelson*
[3]*HortResearch, PB 1401, Havelock North*

ABSTRACT

Four orchards in Canterbury, one in Nelson, and two in Hawkes Bay were monitored by pheromone traps for the presence of two different taxa of *Graphania mutans*, "Auckland" and "Lincoln". Pheromone trap catches indicate that two distinct entities of *Graphania mutans* are present, which vary dramatically in importance between regions. In Hawkes Bay, "Lincoln" was rare compared to "Auckland", in Nelson "Lincoln" was slightly more dominant than "Auckland", while in Canterbury both entities were equally abundant, with identical phenology. In Canterbury, catches of adult males over 4 years peaked in spring or autumn, or both, but were generally low in December and January. In rural Canterbury, an orchard surrounded by irrigated pasture (Winchmore Research Orchard) had a higher incidence of *G. mutans* than an orchard surrounded by dryland pasture, while an orchard surrounded by a diversity of land uses other than pasture had the lowest incidence.

Keywords: noctuid, *Graphania mutans*, pipfruit, phenology, pheromone traps, quarantine pest

INTRODUCTION

A number of noctuid species can be found within New Zealand orchards. *Graphania mutans* (Walker) (Noctuidae: Hadeninae) was considered by Thomas (pers. comm.) to be the most important species in NZ apple orchards, while Dugdale (pers. comm.) suggested that *G. ustistriga* (Walker) would also contribute to the problem, but to a lesser extent.

Research during the late 1980s showed that feeding on apples by noctuid larvae immediately post-flowering accounted for 3-7% of the fruit rejected at harvest, in Canterbury, Nelson and Hawkes Bay (unpublished data). This damage has frequently been mis-identified by apple growers as physical or other insect injury. However, the interception of noctuid egg batches on fruit by quarantine inspectors has been of greater importance to the apple industry in recent years, than has damage caused by larval feeding. Both larval damage and egg deposition occurs in all New Zealand's apple growing regions, with varying frequency.

In 1988 the pheromone components of *G. mutans* collected from Auckland and Lincoln were identified (Frérot and Foster 1991; Frérot *et al.* 1993). Two distinct entities were found to exist, based on the differences in the ratio of the pheromone components. This made pheromone trapping for these entities possible (Suckling *et al.* 1990). The two *Graphania* entities appear to be sibling species, although a taxonomic review has yet to be made. For the purposes of this study, these entities are referred to as *G. mutans* "Auckland" and *G. mutans* "Lincoln". Since the identification of the pheromone for these insects, trapping has been undertaken in a number of apple growing regions. This paper reports on the phenology of *G. mutans* in three apple growing regions.

Proc. 48th N.Z. Plant Protection Conf. 1995: 125-129

METHODS

Green funnel-type pheromone traps (International Pheromone Systems Ltd, South Wirral, UK) were used to monitor *G. mutans* within apple orchards in Canterbury during 1988-89 to 1993-94, in Nelson during 1989-90 and 1993-94, and in Hawkes Bay during 1990-91 and 1991-92. In Canterbury, orchards were sited at Templeton, Halswell, Belfast (Christchurch environs), Eyreton (central Canterbury plains) and Winchmore (southern mid-Canterbury plains). The land-use surrounding these orchards ranged from irrigated and dryland pastures, to suburban housing and scrubland. The Nelson orchard was located at Appleby, and the two Hawkes Bay orchards were in the Hastings environs.

Traps were baited with pheromone impregnated rubber septa containing blends of a) 1000 µg (Z)-9-tetradecenol (Z9-14:OH), 230 µg (Z)-9-tetradecenyl acetate (Z9-14:OAc), 130 µg Z7-14:OH, and 30 µg Z7-14:OAc for *G. mutans* "Auckland"; and b) 1000 µg (Z)-9-tetradecenyl aldehyde (Z9-14:ALD), 150 µg Z9-14:OH, 350 µg Z9-14:OAc, 140 µg Z7-14:OH, and 50 µg Z7-14:OAc for *G. mutans* "Lincoln". Traps were spaced at least 5 m apart, attached to metal standards approximately 1.5 m above the ground, and placed on each orchard boundary. Traps were inspected weekly between October and March, moths removed and numbers recorded. Four traps for each entity were used at each site in Canterbury, while a single trap per entity was used at Appleby Research Orchard, Nelson, and at two Havelock North orchards, Hawkes Bay.

The weekly catches are presented as the mean number per trap per day, to allow graphical presentation of the adult male flight phenology. The seasonal mean catch (October 1 to March 31) was determined for the Canterbury orchards.

RESULTS AND DISCUSSION

Pheromone trapping at four Canterbury orchards, over six seasons, found that both *G. mutans* "Auckland" and "Lincoln" entities were similar in incidence and seasonal phenology. However, trap catches at Winchmore Research Orchard during the 1990-91 season were not consistent with this trend, with a lower incidence of "Auckland" than "Lincoln" (Fig 1). The reason for this difference is not clear. Typically, adult flights occurred to various extents during spring (October/November) and/or autumn (February/March), and were least common during mid-summer (January) The incidence of both entities of *G. mutans* varied considerably between locations and seasons (Table 1). The variation in trap catch for each entity was greatest between sites (up to 200-fold), than between the annual variation (up to 20-fold) at the same orchard.

TABLE 1: Seasonal (Oct 1 - Mar 31) mean catch per trap per day of two entities of *Graphania mutans*, from four Canterbury apple orchards, over six seasons.

Year	Templeton		Belfast		Halswell		Winchmore	
	"Auck"	"Linc"	"Auck"	"Linc"	"Auck"	"Linc"	"Auck"	"Linc"
1988-89	11.9	12.4	0.2	0.1	-	-	-	-
1989-90	12.3	13.2	0.4	0.2	3.5	3.0	37.8	54.2
1990-91	152.6	133.6	1.7	1.3	27.4	23.7	20.3	2.9
1991-92	32.7	28.5	0.2	0.1	24.3	21.9	28.6	33.9
1992-93	12.9	18.2	0.2	0.2	2.4	1.6	15.7	24.7
1993-94	19.9	21.6	0.5	0.3	3.2	2.7	22.5	32.5

In Canterbury, orchards in rural locations had higher numbers of *G. mutans* than did orchards close to urban land uses. Suckling *et al.* (1990) discussed a possible relationship between the incidence of *G. mutans* and the orchard's surrounding land use. Table 1 supports the contention that pheromone trap catch of *G. mutans* increases with an increase in pastoral land use. The two orchards in Table 1 with the lowest

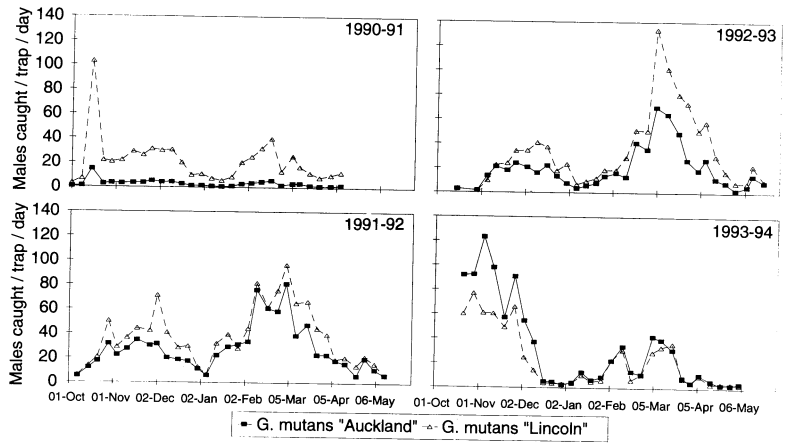

FIGURE 1: Pheromone trap catches of two entities of *Graphania mutans*, from Winchmore Research Orchard, Canterbury, during the seasons 1990-91 to 1993-94.

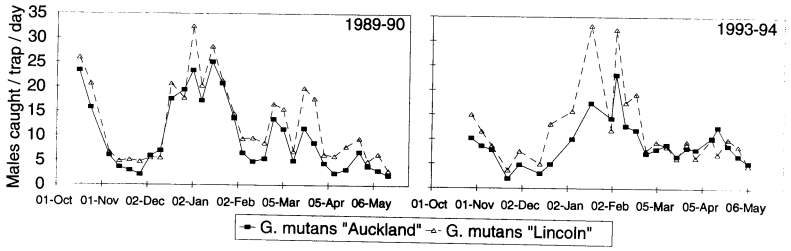

FIGURE 2: Pheromone trap catches of two entities of *Graphania mutans*, from Appleby Research Orchard, Nelson, during the seasons of 1989-90 and 1993-94.

seasonal trap catches (orchards at Belfast and Halswell) were both surrounded by land uses characterised by the presence of urban dwellings, species diverse areas of trees and shrubs, and a relative absence of pasture. In contrast, the orchards with the highest seasonal trap catch (orchards at Templeton and Winchmore) were surrounded by a land use dominated by pasture.

In Nelson, both *G. mutans* entities were trapped (Fig. 2). However, "Lincoln" was caught in slightly higher numbers than "Auckland", during both seasons (22% greater numbers during both 1989-90 and 1993-94). The peak flights occurred during October and January. A period of increased activity also occurred during the autumn of 1989-90 and 1993-94.

In Hawkes Bay, *G. mutans* "Lincoln" was virtually absent (0.7% of total seasonal catch), except for a very low incidence during April/May (Fig. 3, mean of two orchards). While seasonal differences existed in the pattern of male flight activity during 1990-91 and 1991-92, flight activity was similar between orchards.

A comparison of the phenology between Canterbury, Nelson and Hawkes Bay, suggests that all three regions may experience periods of peak flight activity during the spring, summer and/or autumn periods. This observation is supported by North Island light trapping data (McGregor 1987), and other unpublished data from Canterbury

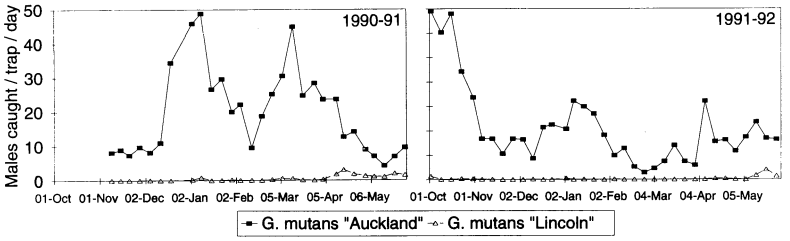

FIGURE 3: Weekly mean pheromone trap catches of two entities of *Graphania mutans*, from two Havelock North orchards, during the seasons of 1990-91 and 1991-92.

apple orchards. None of the orchards studied experienced periods when no *G. mutans* were flying.

While *G. mutans* in orchards poses a risk to growers in the form of spring fruit damage, the greatest risk is from egg batches laid on fruit during the harvest period. Both these risks are a function of adult female incidence and phenology. Risk is greatest during the periods of nil or low insecticide residues on the crop, which correspond with the crop production conditions found during spring (flowering period) and autumn (harvest) (Suckling and Burnip 1993). The data presented suggests that all three regions have the potential to experience large flights of *G. mutans* during spring or autumn. However, Hawkes Bay may experience the greatest risk, due to a consistently greater abundance of noctuids during the harvest period.

A variety of noctuid species have been found in apple orchards, and a number have the potential to act in the manner attributed to *G. mutans*. In 1993-94, fermented molasses bait traps (Suckling *et al.* 1990) were used to trap these species at three Canterbury orchards. *G. mutans* accounted for 26%, 49% and 82% of the total number of noctuids of the subfamily: Hadeninae that were found at three orchards, located at Eyreton, Belfast and Winchmore respectively (unpublished data). One species common at all three orchards was *G. ustistriga*, which has been described by J.S. Dugdale (pers. comm.) as an arboreal feeder common to orchard ecosystems. This is supported by the host plant listings for *G. ustistriga* published by Spiller and Wise (1982). The potential for other noctuid species to be problematic in apple orchards needs to be clarified.

A more in-depth study of the role of *G. mutans* in Hawkes Bay and Nelson has been hampered by a lack of consistent trapping of noctuids over successive years. Unfortunately, no noctuid pheromone trapping occurred during 1992-93 in either Nelson or Hawkes Bay, when the U.S. Department of Agriculture intercepted noctuid egg batches on export fruit from both regions. The risk of noctuid damaged fruit and noctuid egg batches on fruit is likely to be related to the seasonal phenology of adult male noctuids. If this is the case, it should be possible to use pheromone traps to indicate the seasons (or periods of seasons) of high risk from noctuid damage and quarantine interceptions. Additionally, it is likely that meteorological conditions affect the seasonal abundance of noctuids in apple orchards, and if so, the potential exists to use meterological data to predict risk.

Several questions remain unanswered regarding the role of noctuids in New Zealand apple orchards. These include: (1) which noctuid species are responsible for egg deposition during spring and autumn, and (2) whether pheromone trap, meterological or other data can be used to predict the timing and abundance of adult flights. The answers to these questions are needed before useful strategies can be developed to minimise the fruit damage and quarantine risks posed by noctuid species.

ACKNOWLEDGEMENTS

We would like to thank the orchard managers at the respective apple orchards involved in this research, particularly the staff of Applefields and the Produce Group.

REFERENCES

Frérot, B. and Foster, S.P., 1991. Sex pheromone evidence for two distinct taxa within *Graphania mutans* (Walker). *J. Chem. Ecol. 17*: 2077-2093.

Frérot, B. Dugdale, J.S., and Foster, S.P., 1993. Chemotaxonomy of some species of moths in the New Zealand genus *Graphania* based on sex pheromones. *N.Z. J. Zoo. 20*: 71-80.

McGregor, P.G., Watts, P.J. and Esson, M.J., 1987. Light trap records from southern North Island hill country. *N.Z. Entomol. 10*: 104-121

Spiller, D.M. and Wise, K.A.J., 1982. A catalogue of New Zealand insects and their host plants. *N.Z. DSIR Bulletin 231*; 260pp

Suckling, D.M., Thomas W.P., Burnip, G.M. and Robson, A., 1990. Monitoring lepidopterous pests at two Canterbury orchards. *Proc. 43rd N.Z. Weed and Pest Control Conf.*: 322-327.

Suckling, D.M. and Burnip, G.M., 1993. Pheromone trapping and insecticide use in Canterbury apple orchards. *Proc. 46th N.Z. Plant Protection Conf.*: 129-134.