TROPICAL GRASS WEBWORM (*HERPETOGRAMMA LICARSISALIS*): IMPLICATIONS FOR DAIRY FARMING IN NORTHLAND

B.E. WILLOUGHBY[1] and S.A. BARNS[2]

[1]AgResearch, Private Bag 3123, Hamilton, New Zealand
[2]University of Waikato, Private Bag 3105, Hamilton, New Zealand
Corresponding author: bruce.willoughby@agresearch.co.nz

ABSTRACT

The presence of larvae of *Herpetogramma licarsisalis* (tropical grass webworm (TGW)) in pasture on the Aupouri Peninsula in Northland, New Zealand, was confirmed in March 1999. A delineation survey undertaken in late March 1999 found an infested area of approximately 37 000 ha, of which 4450 ha was in dairying. The establishment of TGW in the area has been confirmed by ongoing monitoring of populations from 1999 to the present. Populations decline to extremely low numbers over the winter months with the main pasture damage period in early autumn (March/April). Infestations to date have been mainly confined to kikuyu pastures. In 1999 and 2002 visual estimations were made of pasture damage by TGW. The implications of this damage are discussed within the context of management practices and economic constraints for dairy farming in the area.
Keywords: *Herpetogramma licarsisalis*, tropical grass webworm, dairy farming, economic impact.

INTRODUCTION

Herpetogramma licarsisalis (Walker) (Lepidoptera: Pyralidae), commonly called the tropical grass webworm (TGW), is widely distributed in Japan, Hawaii (but not continental USA), South East Asia, the Pacific islands and northern Australia (Common 1990; Tashiro 1976). In Australia it is common throughout Queensland and northern New South Wales. Recently, extensive populations of tropical grass webworm have been recorded in Southern Spain and Portugal (Goater & Knill Jones 1999). TGW is especially damaging to kikuyu (*Pennisetum clandestinum*) in late summer and autumn, but feeds on a wide range of monocotyledonous plants including other C4 grasses and cereals (Grant 1982; Murdoch & Tashiro 1976; Tashiro 1976).

The adult female moth lays an average of 250 eggs over a 2–3 week period. The larvae mature in about 2 weeks, feeding at night and remaining inactive in webbing tunnels during the day. The complete life cycle takes about 16 days at 31°C, and in tropical regions there are continuous generations throughout the year (Tashiro 1976). Thus TGW has probably established at the limits of its geographical range in Northland with pasture damaging populations confined at present to the Aupouri Peninsula.

Pastoral farming in Northland has become reliant on kikuyu since it was released in the region in 1920 (Patterson 1921). This paper looks at the economic implications of tropical grass webworm on dairy farming on the Aupouri Peninsula in Northland.

METHODS

In the course of the 1999 delineation survey the area of pasture damage by TGW within 33 paddocks was visually estimated. This survey was made within the main infestation locus (Fig. 1) across all classes of pastoral land with estimations made of paddock size and proportion damaged. A similar assessment of pasture damage was made on 150 paddocks in 2002. Damage levels in both surveys were stratified into six levels from zero to extreme, where zero is no damage; 10% is very low; 30% is low;

50% is medium; 70% is high; and 90% is extreme. Using a probability distribution function the initial probability of pasture damage was calculated for both 1999 and 2002 representing the situation before pasture damage from TGW was apparent. From probability revision (Samson 1988) these probabilities were reassessed (conditional probability) for the situation when the decision to implement management strategies was made after pasture damage was apparent.

An expected value methodology (Samson 1988) was used to calculate the financial returns for a range of both proactive and reactive actions. Expected values were calculated from the probability of each pasture damage level and the cost of possible remedial actions. In each instance the action was costed to fully maintain production levels and only for the period of damage. Flow on costs were not considered. Costs were direct costs (excluding GST) obtained from retailers and service providers in March 2002, and

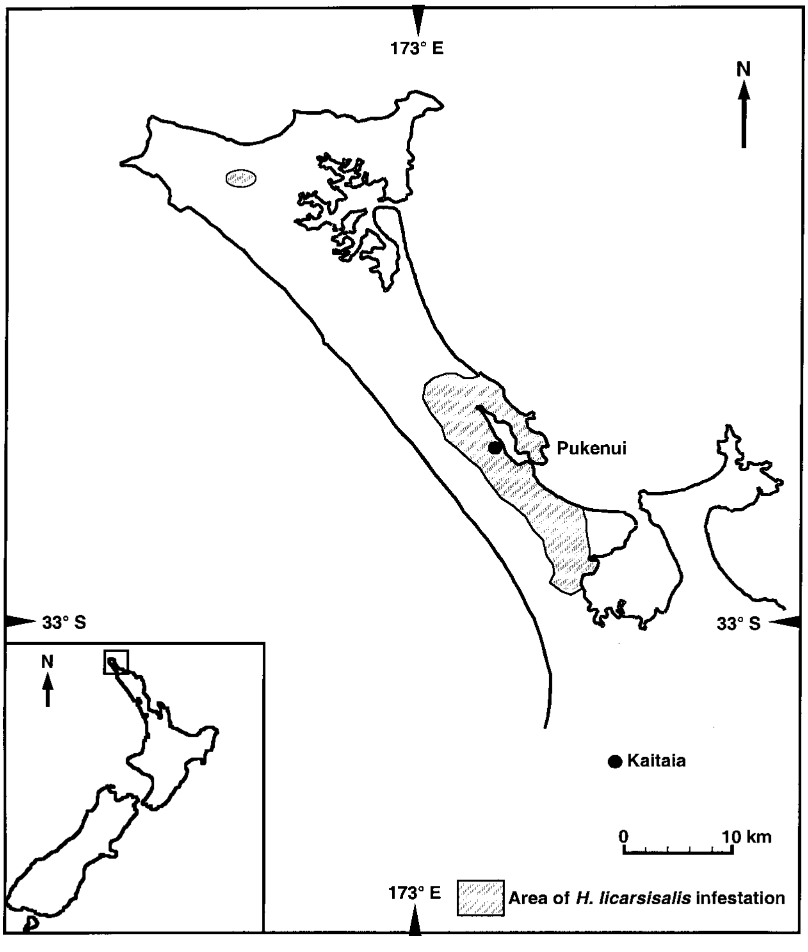

FIGURE 1: Distribution of *H. licarsisalis* (tropical grass webworm) on the Aupouri Peninsula, Northland, in April 1999 (from Willoughby & Hardwick 1999).

did not include farmer time. Projections of the impact of decisions on profitability were based on an 89 ha farm, with 137 (79%) milking cows and 37 (21%) replacement heifers. The income for each season was estimated on the basis of 263 kg milksolids produced by each cow valued at $3.48 per kg in 1999 and $5.27 per kg in 2002, plus calf sales averaging $160 per calf.

Much of the information on land use and farm practice is unpublished and was gained in interviews with farm consultants.

RESULTS AND DISCUSSION

The 1999 TGW infestation loci on the Aupouri Peninsula are shown in Figure 1. The Pukenui locus extended 15.8 km north of the township and 28.7 km to the south. This encompassed an area of approximately 37 400 ha of which approximately half (16 000 ha) was forestry. Within the area, infestations were sporadic in nature and confined to kikuyu pastures.

Climatic implications and impact of TGW

While the climate of Northland can be described as subtropical, with a mean annual temperature of 15.6°C (14.7–16.9°C), it is not a favourable environment for tropical grass webworm (Tashiro 1976). The coldest month is August with a mean temperature of 12.1°C (11.3–12.8°C). The winters are generally wet with a mean rainfall of 468 mm (157–928 mm). In El Nino years there is generally a summer dry period of 3 weeks (range 2–5 weeks). However, the Aupouri Peninsula with its long narrow configuration has a strong maritime influence and is 2-3°C warmer on average than other areas in the north of Northland. La Nina conditions produce moist summer conditions in this region. The summer of 1998/99 was no exception, producing lush kikuyu growth and ideal conditions for the survival and growth of TGW eggs and larvae. Pasture damage from this pest tends to be confined to the autumn months of March and April. Winter survival of TGW is dependant on populations surviving in micro climates (Hardwick 2000). These exist on north-facing slopes where temperatures may be as much as 5°C above the grass maximums recorded on flat pastures (Gillingham & Bell 1977).

Pastoral farming trends on the Aupouri Peninsula

Dairy farming ranks second to beef in importance on the Aupouri Peninsula, occupying just under half of the pastoral farming area. Other pastoral farming activities include, beef, beef and sheep, and deer (Table 1). Dairy farming is the most intense farming activity at 2 cows/ha, double the beef stocking rate.

TABLE 1: Predominant farm types on the Aupouri Peninsula at 2002[1].

Description	Average herd size	Average hectares	Number of properties
Dairy	175	89	50
Deer	158	70	5
Beef	90	93	170
Mixed beef and sheep	441 beef 1598 sheep	691	11

[1]Source: AgriQuality(D.Scott); Fonterra (J. Bryant).

Recently dairy farming in the Far North has been characterised by shifts towards fewer, larger farms, changes in land use from dairy to beef, and subdivision, especially into lifestyle blocks (J. Bryant, pers. comm.). These trends mirror those in Northland generally, where the Ministry of Agriculture and Forestry reports fewer farms, but the same numbers of cows, with changes made up of amalgamations and moves into dry stock (MAF 2001a).

Current farm practices

While spring calving is prevalent on the Aupouri Peninsula, 10 of the 50 dairy farms in the area hold current winter milk contracts (J. Bryant, pers. comm.). The peninsula has a mild winter and sandy soils making the area easy wintering country. However, the ability to meet quantity requirements of winter milk contracts can be inhibited by a dry autumn, which is often a feature of the local climate.

Kikuyu is important to farming throughout Northland, and particularly so on the Aupouri Peninsula. This C4 grass occurs on approximately 80% of farms and covers over 75% of the farm area (Andrewes & Jagger 1999). The prevalence of kikuyu is increasing in Northland pastures (MAF 2001b).

Impact of tropical grass webworm

From damage surveys, the probability of no to very low levels of pasture damage was 80% in 1999 compared to 99% in 2002. In 1999 once pasture damage had occurred (conditional event), the probability that it remained at very low to low levels was 86%, with a 3% chance that the damage would be medium or extreme and a 8% chance that it would be high. In 2002 the probability that pasture damage remained very low was 99.5%. The impact of tropical grass webworm on pastures on the Aupouri Peninsula in 1999 was considerably greater than 2002.

TABLE 2: Probabilities of various levels of pasture damage from TGW infestation in 1999 and 2002.

Pasture damage level	None	Very low	Low	Medium	High	Extreme
Initial 1999	0.40	0.40	0.117	0.017	0.05	0.017
Conditional 1999		0.666	0.195	0.028	0.083	0.028
Initial 2002	0.797	0.202	0.00	0.001	0.00	0.00
Conditional 2002		0.995	0.00	0.005	0.00	0.00

The expected costs of proactive strategies at each level of infestation are shown in Table 3. An assumption has been made that there is no unused carrying capacity and ideally decision support tools to identify risk of TGW damage should exist, but don't. The insecticide option does not include application costs and a less expensive IGR may be used. The cost of buying in feed reflects the prices when there is less demand. On farm supplements in the form of silage and crops may be planned to be available at times of predicted feed shortage. Pasture management options include grazing, mulching or harrowing at risk pastures to a maximum of 15% of the property. Specific pest management strategies beyond this level would encroach on current feed requirements. Costs incurred beyond this level of damage, if this is the sole strategy, are assumed to be the equivalent of doing nothing. Using probabilities depicting both 1999 and 2002 levels of infestation, the strategy of insecticide application has the lowest expected cost. The expected cost of delaying a decision at this point is computed by the initial probability times the average expected cost of each reactive strategy at each level of infestation and represents the dollar risk to the farmer.

Table 4 depicts the second decision point, when TGW pasture damage has been observed. An assumption has been made based on the authors' observations of the rate at which pasture damage occurs (e.g. 2 days to destroy 20 ha) that damage containment apart from the use of insecticide will be ineffective. If there is no infestation, the costs of all strategies are zero, and the decision to delay action has proved beneficial. However, if TGW are present, the expected cost varies with the level of infestation. At this point the insecticide strategy has the lowest cost, but would be insufficient on its own to retain production because pasture loss has already occurred. The cost of the spraying is greater than when taken proactively as a more expensive but faster acting organophosphate insecticide must be used to limit pasture damage. While the decision to apply insecticide

TABLE 3: Proactive response. Expected cost ($) of strategies to manage TGW infestations at six levels of pasture damage.

Pasture damage level	Insecticide	Buy in feed	On-farm supplements	Pasture management	Delay Decision (1999)2002
Nil	0	0	0	0	(0)0
Very low	196	746	1363	1780	(681)344
Low	587	4770	5247	9391	(1002)0
Moderate	979	9638	7582	18352	(282)17
Severe	1371	28718	26662	27318	(1231)0
Very severe	1762	47245	45189	36266	(521)0
Expected cost 1999	260	3212	3344	4069	3717
Expected cost 2002	41	160	283	378	361

for damage limitation may reduce the costs of other strategies, the costs of strategies increase as pasture damage from TGW infestation increases. Buying in feed at this point is largely restricted to commercial feed sold at farm retail outlets while pasture management is unavailable to the farmer as pasture loss has already occurred. The lower levels of TGW infestation in 2002 substantially reduced the expected cost of all strategies.

The impact of the remedial strategies as a percentage of gross revenue does not exceed 8.6% in either 1999 or 2002 (Table 5). This cost is based on the reactive strategy of buying in feed to maintain production. Proactive strategies did not exceed 2.8% in 1999 and 0.2% in 2002. Income per kg from milk solids in 1999 was $3.48 and in 2002 was $5.27. This represents a 51% increase in income which, combined with the lower levels of TGW infestation, reduced the financial impact of this pest in 2002. However, income in 2003 is expected to be $4.00. The price variation in the main reflects the value of $NZ against our main trading partners and as such is outside of a farmer's influence. However, it does give a risk context against which to measure the effect of TGW on farm profitability.

The scenarios using probabilities based on the 1999 and 2002 TGW infestations both demonstrate the financial advantages of acting proactively. The average costs of reactive strategies for 1999 levels of infestation are generally double the proactive costs, while for 2002 the average increase in costs was greater than nine times (Tables 3 & 4). However, the average cost of a proactive strategy in 2002 was 91% less that in 1999,

TABLE 4: Reactive response. Expected cost ($) of strategies to manage TGW infestations at six levels of pasture damage.

Pasture damage level	Do Nothing	Insecticide	Off-farm grazing	Buy in feed
Very low	4481	712	940	2386
Low	13442	2136	2820	17693
Moderate	22403	3560	4701	36513
Severe	31364	4984	6581	55544
Very severe	40325	6408	8461	73942
Expected cost 1999	9932	1578	2084	12676
Expected cost 2002	4570	726	959	2556

TABLE 5: Expected costs of remedial strategies as a % gross revenue for 1999 and 2002.

Action	1999 Proactive	1999 Reactive	2002 Proactive	2002 Reactive
Do nothing	-	6.7	-	2.2
Insecticide	0.2	1.1	<0.1	0.3
Off-farm grazing	-	1.4	-	0.5
Buy in feed	2.2	8.6	0.1	1.2
On-farm supplements	2.3	-	0.1	-
Pasture management	2.8		0.2	
Delay decision	2.5		0.2	

falling from $2965 to $262. The average cost of a reactive strategy was 66% less (from $6567 to $2203) reflecting the lower probabilities of damage. Based on 2002 levels of infestations, dairy farmers may be more willing to delay action.

Although TGW has the potential to devastate kikuyu pastures in Northland, while climatic conditions remain marginal for population development, this is unlikely to be realised. Kikuyu is stoloniferous by nature and usually survives defoliation by TGW but serious infestations will likely have a carry-over effect to following years. In 2001 the dairy farming gross revenue in Northland was $1676 per cow (MAF 2001a) compared to gross revenue on the Aupouri Peninsula of $1465 per cow. The 14% less income can be taken as another indication of the impact of TGW on profitability. Timely warning to farmers on the probability of a TGW outbreak would be a valuable management tool for this area.

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