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Evaluation of pheromone trapping of diamondback moth (*plutella xylostella*) as a tool for monitoring larval infestations in cabbage crops in Samoa

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Abstract
Studies were conducted at Aleisa and Alafua in Samoa, during 2004/2005, to assess the propriety of using pheromone trapping of Plutella xylostella as a tool for monitoring larval infestations in cabbage crops. Numbers of adults and larvae of P. xylostella present in cabbage crops were monitored, concurrently, on a weekly basis at the two sites over a period of 13 and 15 months, respectively. Numbers of P. xylostella adults were monitored by using pheromone traps which were set up in cabbage fields, whereas numbers of larvae were monitored through visual observation of cabbage plants in the same fields where the pheromone traps were placed. Results showed that numbers of P. xylostella adults caught in pheromone traps were positively correlated with larval infestations in the crops (r = 0.894 for Aleisa, r = 0.589 for Alafua). Number of moths caught in traps explained 79.9% and 34.4% of variation in larval infestations at Aleisa and Alafua, respectively.
Keywords: *Plutella xylostella, pheromone trapping, monitoring, cabbage, Samoa.*

1 INTRODUCTION

Diamondback moth (DBM), *Plutella xylostella* (L.) (Lepidoptera: Plutellidae), has been described as the most destructive insect pest of head cabbage and other crucifers in Samoa (Hollingsworth *et al*. 1984; Anonymous 1996) as well as in other parts of the world (Talekar and Shelton 1993). The method most commonly used by farmers in Samoa to control this and other cabbage insect pests is by using synthetic insecticides, which are applied regularly from planting until harvest. However, it has been reported that DBM has the tendency to develop resistance to insecticides used against it (Talekar *et al*. 1985, 1990; Iqbal *et al.* 1996). Therefore, it is widely agreed that an integrated approach is the best way of achieving a sustainable management of this pest. It is also a well known fact that effective and efficient pest monitoring is an essential element of an integrated pest management system.

Previous reports by several workers have indicated that pheromone trapping can be used as a monitoring tool in the management of DBM. In this regard, Baker *et al*. (1982) and Walker *et al*. (2003) had found that adult DBM catches correlated with larval populations in crops being monitored. Baker *et al*. (1982) had also found that adult DBM catches correlated with subsequent larval populations that occurred 11 to 12 days later. In New Zealand, Walker *et al*. (2003) found that increases in adult DBM trap catches predicted increases in larval infestations in some crucifer crops by two to three weeks. In India, Reddy and Guerrero (2001) reported that low numbers of adult DBM in pheromone traps was associated with low levels of damage caused by DBM larvae in cole crops. Capinera (2000) also stated that pheromone traps may predict DBM larval populations 11 to 21 days later.

According to Walker *et al*. (2003), data from pheromone trapping can assist in decision making by helping farmers to identify risky periods when larval numbers in crops are likely to increase to damaging levels. They indicated that pheromone trapping could replace the need to scout crops for larvae. This would be advantageous because, according to Baker *et al*. (1982), it is difficult to sample DBM larvae in the growing crop due to their small size and tendency to be concealed in the heart leaves. Based on their study, Reddy and Guerrero (2001) also concluded that pheromone trapping was a selective and efficient tool for timing insecticide application in an IPM programme. In another study, Reddy and Guerrero (2000) found that an IPM programme based on DBM pheromone trap catch threshold, natural enemies and selective use of insecticides, was more effective in reducing the level of DBM damage compared to management based solely on insecticide use.

This paper reports the findings of an investigation carried out to assess the propriety of using pheromone trapping for monitoring diamondback moth in cabbage crops under field conditions in Samoa.

2 METHODS

This investigation involved recording the numbers of DBM adults caught in pheromone traps mounted in cabbage crops, numbers of DBM larvae present in those crops, and analysis of these two categories of data to determine the nature of relationship between them.

The investigation was carried out at two locations on Upolu Island, Samoa, during 2004 and 2005. One location was a small commercial farm at the village of Aleisa (13.88°S, 71.88°W), where cabbage was planted in an overlapping manner all-year-round. It was noted that insecticides (indoxacarb and pirimiphos-methyl) were sometimes applied to control leaf-eating caterpillars in the cabbage crops at this site. The second location was an experimental area at Alafua (15 – 17°S, 171 – 173°W), where cabbage was planted repeatedly nearly all-year-

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round. No insecticides were applied to control pests in the

3 MONITORING OF DBM ADULT AND LARVAL NUMBERS

Commercial DBM pheromone lure capsules [containing Z11-16:Ac (cis-Hexadecenyl acetate), Z11-16:Ald (cis-11-Hexadecenal), and Z11-16:OH (cis-11-Hexadecenol) (30:60:10)] placed on sticky bases in delta traps were used to monitor DBM adult numbers. The traps were monitored on a weekly basis over 15 and 13 months at Aleisa and Alafua, respectively. Trapping was done in the period between March 2004 and June 2005 in cabbage plots measuring 0.01ha to 0.0025ha. Two traps were mounted on wooden poles in a cabbage plot at each of the two locations. Traps were adjusted to hang just above the crop canopy at all growth stages. Lures and sticky bases were replaced every four weeks or sooner if the sticky surface lost its stickiness, for example due to being clogged with insects. Traps were monitored weekly and data were recorded on the numbers of DBM adults caught per trap. After counting and recording the number of moths caught, moths were removed from the sticky trap base and discarded. Mean number of DBM adults caught per trap per week was calculated for each site.

Data was also collected, concurrently, on DBM larval infestations in the cabbage plots where the traps were set up. Average number of DBM larvae present on 30 randomly selected plants was determined in each plot at weekly intervals. To do the observation, leaves of each randomly selected cabbage plant were carefully examined *in situ* in order to locate and count the number of DBM larvae present. DBM larvae were not removed from the plants after counting.

The data for moth trap catches and larval infestations were compared in order to determine whether or not there was a correlation between them. The nature of relationship between the two types of data was assessed by correlation

cabbage crops at this site.

coefficient analysis and linear single regression, using Minitab statistical package version 11.

4 RESULTS

Population trends between adult DBM catches and larval infestations were similar at the two locations; when trap catches increased, larval infestation also increased correspondingly (Figure 1 and 2). At Aleisa, insecticides were sometimes applied to control leaf-eating caterpillars including DBM; this obviously would have reduced the number of DBM larvae present in the crop relative to the number of DBM adults during those times. Correlation analysis of data obtained showed significant correlation (at P = 0.05) between the number of moths caught in the pheromone traps and larval infestations in the crops, but the relationship was stronger at Aleisa than at Alafua (r = 0.894 and r = 0.589, respectively). Also for both locations, linear regression analysis showed significant association (at P = 0.05) between trap catches and larval numbers. The regression equation for Aleisa was y = 0.0292 + 0.0648x and number of moths in the traps explained 79.9% of the variation in larval infestation. For Alafua, the regression equation was y = 0.090 + 0.0670x and number of moths in the trap explained 34.4% of the variation in larval infestations. The weaker relationship observed at Alafua is probably due to the generally low populations of DBM at this site, which in turn is thought to be mainly due to low levels and sometimes absence of cabbage crops at this site. Although Baker *et al*. (1982) and Walker *et al*. (2003) reported that adult DBM trapping predicted increases in larval infestations that occurred one or more weeks later, no distinct time lapse was observed between the onset of adult moth catches and larval infestations in corresponding crops in this present study (Figures 1 and 2).

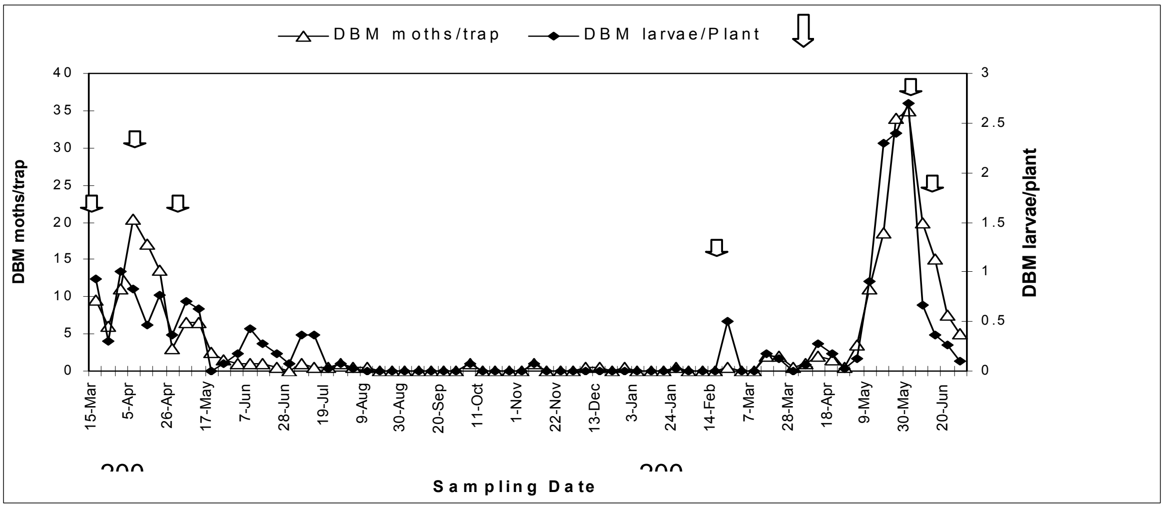

Figure 1. Weekly catches of adult *Plutella xylostella* in pheromone traps and weekly counts of larvae on cabbage plants at Aleisa, Samoa.

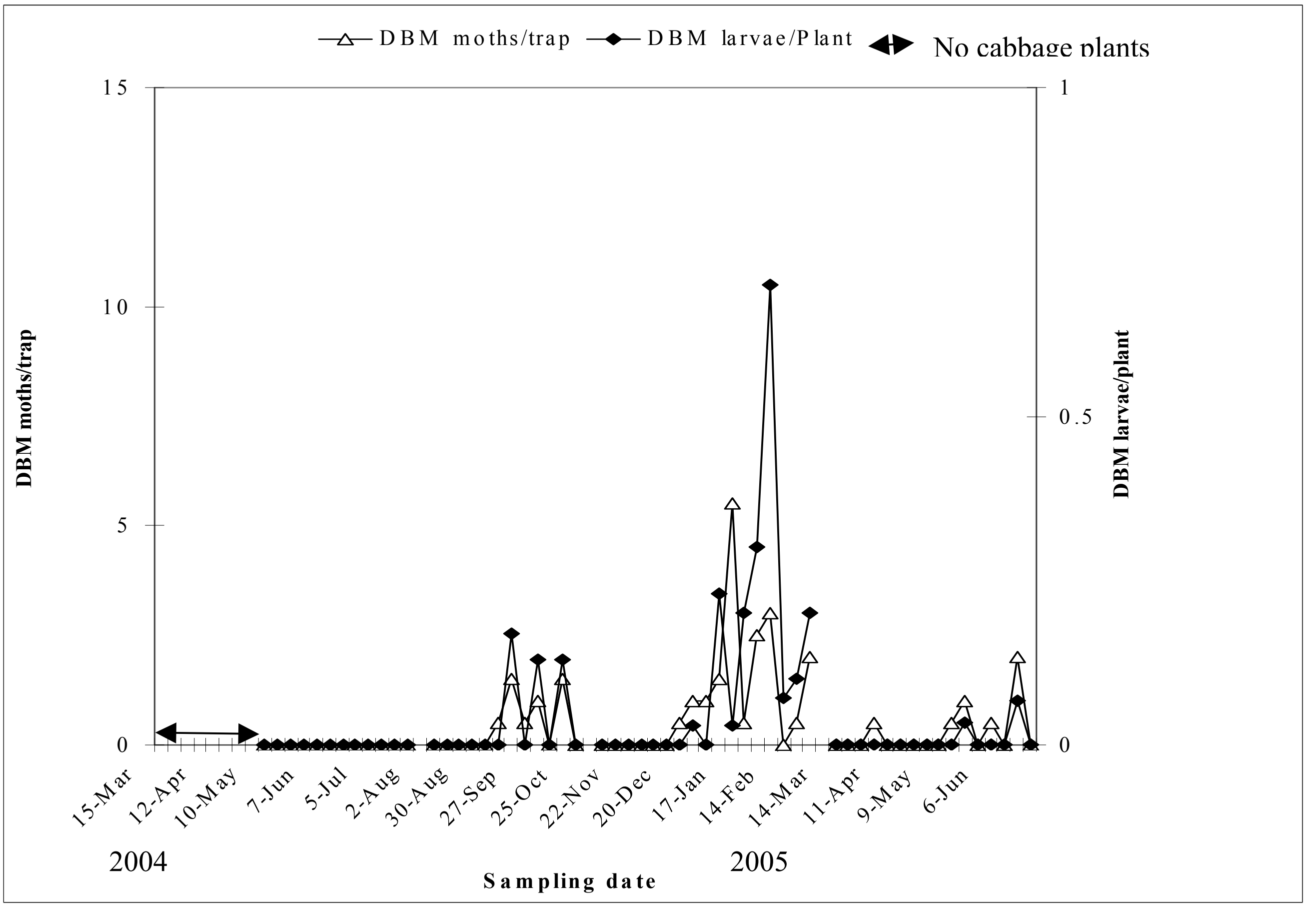

Figure 2. Weekly catches of adult *Plutella xylostella* in pheromone traps and weekly counts of larvae on cabbage plants at Alafua, Samoa.

At Aleisa, DBM adult catches were relatively high from March 2004 to the last week of May 2004 and again from May 2005 to June 2005, but moth numbers were either very low or absent from June 2004 to April 2005 (Figure 1). The highest peaks were recorded in the second week of April 2004 and last week of May 2005, indicating that peak moth activity was generally around similar periods in both years. Larval infestations were relatively high in the months of March 2004 to July 2004 and again from February 2004 to June 2005, but was either very low or absent between August 2004 and mid February 2005 (Figure 1).

At Alafua, there was no cabbage crop in March to the last week of April 2004. Relatively higher adult and larval populations were recorded in January to February 2005 (Figure 2). Outside these periods, DBM was either absent or at very low population levels. The highest peak at this site was in the third week of January 2005. Catches of DBM adults and larval infestations were generally low at this site compared to Aleisa (Figure 1).

5 DISCUSSION

Results from this study showed that moth trap counts and larval infestations were positively correlated, so that when the number of moths caught in the pheromone traps increased, the number of larvae infesting the cabbage plants also increased (Figures 1 and 2). This positive relationship was observed for both locations. These observations are similar to those of Baker *et al*. (1982), Reddy and Guerrero (2001) and Walker *et al*. (2003) who found that adult DBM catches correlated with subsequent larval populations and damage levels. Consequently, Walker *et al*. (2003) have concluded that pheromone-based monitoring can be used to identify periods of DBM larval infestations and facilitate decision making concerning timing of insecticide application. Pheromone trapping is an easier tool for monitoring infestation levels compared to scouting for larvae in a crop (Baker *et al*. 1982). Therefore, the findings from this present study suggest that it is also possible to use levels of DBM adult catches in pheromone traps to predict changes in levels of DBM larval infestations in a cabbage crop in Samoa.

However, although findings from this present study and previous reports (Baker *et al*. 1982; Capinera 2000; Reddy and Guerrero 2001; Walker *et al*. 2003) suggest that pheromone trapping could be a useful tool for monitoring DBM infestations in cabbages, there are indications that it may not be so useful in some situations. For instance, it appears that its efficiency for predicting larval infestation levels is influenced by the population of moths. This is because it was observed that at Alafua, where DBM populations were comparatively very low, the number of moths caught in the trap explained only 34.4% of the variation in larval infestations (regression equation $y = 0.090 + 0.0670x$). In comparison, the number of moths caught in traps explained 79.9% of the variation in larval infestation at Aleisa where DBM moth populations were higher(regression equation y = 0.0292 + 0.0648x). It also appears that pheromone trapping is not an efficient tool for monitoring larval infestations when populations are high, since Walker *et al*. (2003) found that large moth catches were not useful for predicting larval infestations. Further, it is envisaged that monitoring DBM infestations through pheromone trapping would be of little practical value during periods when other important pests of the crop are likely to occur concurrently, as was usually the case during this study, because crop scouting would still be necessary for the other pests. A similar view has also been expressed by Walker *et al*. (2003).

In conclusion, findings from the present study suggest that pheromone trapping could be useful as a tool for monitoring DBM larval infestations in cabbage crops. It is easier to conduct than crop scouting for pests. However, the tool would be of little value under very low or high DBM populations, and during periods when crop scouting is also required for monitoring other important pests of the crop. Since the latter is a likely scenario in Samoa, crop scouting would still be the preferred method for monitoring DBM and other cabbage pests in the country.

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