DICARE\textsuperscript{R} WG37.5 as a partner of anti-resistance strategy programme for the control of diamondback moth \textit{(Plutella xylostella} \textit{L.}) in Thailand

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Abstract

DICARE\textsuperscript{R} WG37.5 is a mixture of POLO\textsuperscript{R} (diafenthiuron) and INSEGAR\textsuperscript{R} (fenoxycarb). POLO\textsuperscript{R} is a representative of a novel chemical class of insecticide, highly active on \textit{Plutella xylostella} at 50 g ai/hl, whilst INSEGAR\textsuperscript{R} (fenoxycarb) is a new juvenile hormone analogue with typical growth regulating features, especially interference with the last larval moult and, or ovicidal activity against many lepidopterous pests, at 10–15 g ai/hl.

In Thailand, resistance development of \textit{P. xylostella} and \textit{Spodoptera exigua} remains a critical factor in shortening the product life cycle of efficacious insecticides, as farmers repeatedly apply effective products. Usually the two pests are observed in a mix population, damaging/destroying cruciferous crops. If an insecticide is only effective on one of these pests, the farmer would mix/cocktail with other insecticide in order to control both pests.

Following laboratory test during 1994–1995, DICARE\textsuperscript{R} 37.5WG, was then evaluated in the farmers’ fields under practical use conditions.

Under laboratory test, DICARE\textsuperscript{R} (300 ppm POLO\textsuperscript{R}+100 ppm INSEGAR\textsuperscript{R}) was very effective against both the egg stage and the last instar larvae of \textit{P. xylostella}. Whilst under field conditions, DICARE\textsuperscript{R} (30 g ai/hl POLO\textsuperscript{R}+7.5 g ai/hl INSEGAR\textsuperscript{R}), proved effective against \textit{P. xylostella} on Chinese kale. In addition, alternate application of DICARE\textsuperscript{R} with RAMPAGE (chlorfenapyr) clearly out performed all other treatments, thus proving that DICARE\textsuperscript{R}, applied alternately with other effective insecticides, not only provides best control of \textit{Plutella xylostella} but also can be applied in an IRM programme to further prolong the life cycle of effective products in the market.

In conclusion, IRM should continue to be strongly promoted, developed as an effective tool for a better control of \textit{P. xylostella} and other lepidopterous pests in Thailand and other countries.

Key words: Diamondback moth, DICARE, mixtures, insecticide resistance management

Introduction

Diamondback Moth (DBM), \textit{Plutella xylostella} (L.) (Lepidoptera : Yponomeutidae) is one of the most serious insect pests of cruciferous crops all over the world (Hill, 1975). In Southeast Asia, it is a serious pest of cabbage, Chinese kale, Chinese cabbage, leaf mustard, Chinese radish and cauliflower. In Thailand, diamondback moth is generally prevalent from February to April when optimum climatic conditions and food plants are more readily available. However, in many areas of the central plain where crucifers are planted all year-round, diamondback moth damage can be observed throughout the year (Rushtapakornchai and Vattanatangum, 1984). Damage from diamondback moth has been prevented only by spraying of chemical insecticide. However, application in large quantity and repeat use of the same chemical is always threatened by the development of resistance in a short period of time (Miyata \textit{et al.}, 1986). In Thailand, the microbial insecticide, \textit{Bacillus thuringiensis} (Bt) has been used for diamondback moth control since 1972. Most commercial Bt products available belong to HD-1, \textit{var. kurstaki}, serotype 3a/3b.

Field evaluation of these products in 1986 showed promising results in only the northern area but not in the central plains and a loss of the Bt’s efficacy was observed if it is applied just before an irrigation (Rushtapakornchai and Vattanatungum, 1986).

Ciba-Geigy, as a chemical company, is interested to evaluate a new product, DICARE WG37.5 for the control of DBM in the Southeast Asian countries. DICARE WG37.5 is a mixture of POLO\textsuperscript{R} (diafenthiuron) and INSEGAR (fenoxycarb). POLO\textsuperscript{R} is a representative of a novel chemical class of insecticide, which is highly active on \textit{P. xylostella} at 50 g ai/hl (hectoliter) (Streibert and Kaeding, 1994), whilst INSEGAR (fenoxycarb) is a new juvenile hormone analogue with typical growth regulative features, especially interference with the last larval moult and, or ovicidal activity against many lepidopterous pests, at 10–15 g ai/hl (Senn and Frischnecht, 1994). The evaluation were therefore carried out to determine the following:

1. Efficacy of DICARE (POLO/INSEGAR) vs \textit{P. xylostella} under laboratory conditions.
(2) Efficacy of DICARE (POLO/INSEGAR) vs P. xylostella under field conditions.

(3) Application strategy of DICARE as a partner in anti-resistance programme vs P. xylostella in comparison with the farmer’s practices.

Materials and Methods

Laboratory conditions (Ciba-Geigy R&D Station, Tak Fah)

- **For eggs test:** 16 potted cabbage plants (1 month old) were placed in the mating cage in which 100 pairs of P. xylostella adult moths are released for 2 days to allow oviposition on the leaves. Remove the cabbage plants from the cage. POLO SC250 (300 ppm), INSEGAR WP25 (100 ppm) and a mixture of POLO+INSEGAR (300+100 ppm) were employed in the test.
  - Total no. of treatments: 4, including untreated check
  - Total no. of replicates: 4 (1 potted cabbage plant/rep)
  - Total cabbage seedlings for this test: 16
  - Number of eggs on the leaf surface were recorded
  - Chemical solutions, according to the treatment list were applied individually thoroughly the whole plant with hand spray (10 ml/plant).

- **Chemical solutions:**
  - POLO SC250 (300 ppm)
  - INSEGAR WP25 (100 ppm)
  - POLO+INSEGAR (300+100 ppm)

- **Data collection:**
  - Number of newly hatch larvae/plant were recorded
  - Number of larvae/plant at 3 days after application were recorded
  - % mortality was calculated

![Figure 1. Effect of POLO, INSEGAR and POLO+INSEGAR on eggs of Plutella xylostella](image1)

![Figure 2. Effect of POLO, INSEGAR and POLO+INSEGAR on Plutella xylostella (L1), (L2) and (L3).](image2)

![Figure 3. Bioefficacy of DICARE on Plutella xylostella on Chinese kale at Bang Bua Thong with 5 days intervals.](image3)
For larval test: Potted cabbage plant and chemical preparations were made in the same way as the egg test.
- Chemical solutions were applied individually thoroughly the whole plant with hand spray, according to the treatment list (10 ml/plant)
- The treated leaves were cut and put in the plastic box, accordingly.
- Total no. of treatments: 4, including untreated check
- Total no. of replicates : 4, 1 leaf/rep

Field trials: A suspension concentrate formulation of POLO (diazinon), 250SC, INSEGAR (fenoxycarb) 25WP and a ready mixed formulation
- 80 L1, 80 L2, 80 L3 (for 4 reps) were transferred to the treated leaves, according to the treatment list: check, POLO (300 ppm), INSEGAR (100 ppm) and POLO+INSEGAR (300+100 ppm), respectively.
- Number of dead larvae at 3 and 5 days after application were recorded
- % mortality was calculated
Foliar application of POLO (50 g.ai/hl), and POLO+INSEGAR, 30+7.5 or DICARE 37.5 g ai/ha with a spray volume of 1000 L/ha were made with local standard treatments and untreated check. The applications were timed on eggs, and young *P. xylostella* larvae (L1, L2 & L3). The first application was made when eggs was observed on the leaves or 2–3 weeks after sowing. The assessments were made by counting the number of living larvae and pupae on 10–20 plants per replicate, and/or a final leaf damage rating at just before harvest. Marketable yield was also recorded.

**Results & Discussion**

- **Under laboratory condition**
  - **Egg test:** POLO+INSEGAR, 300+100 ppm showed superior ovicidal effect to either POLO or INSEGAR. Very high % mortality of the newly hatched larvae at 3 days (72 h) after application was also recorded in a POLO+INSEGAR treatment (Figure 1).
  - **Larval test:** POLO+INSEGAR, 300+100 ppm showed superior larvicidal effect than either POLO
or INSEGAR. Very high % mortality of the L3 larvae at 5 days (120 h) after application was also recorded in a POLO+INSEGAR treatment (Figure 2).

**Field trials**

At Bang Bua Thong (BBT) and Krathumban (KBT), DICARE® 37.5 g ai/hl at 5 days intervals with a spray volume of 1000 L/ha was effective against *P. xylostella* and superior to abamectin, 1.8 g ai/hl and fipronil+tebufenozide, 5+30 g ai/hl. However DICARE was inferior to chlorfenapyr, 15 g ai/hl. (Figure 3).

When DICARE, 37.5 g ai/hl was applied at 3 days intervals, the bioefficacy on *P. xylostella* increased and comparable to chlorfenapyr, 15 g ai/hl. (Figures 4 and 5). B. DICARE as a partner in an anti-resistance strategy programme against *P. xylostella*.

Trials were conducted at Bang Bua Thong, in comparison with farmer’s practices. The results showed that DICARE (37.5 g ai/hl) applied right at the beginning and in alternation with chlorfenapyr 20 g ai/hl gave good control of *P. xylostella*. Percent *P. xylostella* control and the marketable yield were taken into account (Figures 6, 7, 8, 9 and 10).

**Conclusions & Recommendations**

DICARE® (POLO+INSEGAR) at 300 ppm+100 ppm under laboratory condition, and at 37.5 g ai/hl under field condition showed enhancement of activity in the control of *P. xylostella*. Besides, DICARE can be considered as an ideal partner in an anti-resistance strategy programme for the control of *P. xylostella* and/or *Spodoptera exigua* in cruciferous crops. In order to maintain the effective life of an insecticide, the recommendations for use of DICARE on cruciferous crops are as follows:

1. Do not apply DICARE repeatedly.
2. Alternate DICARE with other *P. xylostella* effective products
3. DICARE should be applied right at the beginning of *P. xylostella* infestation (oviposition period).
4. Apply only 2 applications of DICARE/crop.

**References**


