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RNAi Technology a New Insight to Control Dimond Back Moth

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SUMMARY

The Diamondback Moth (DBM), scientifically known as Plutella xylostella (L.), is a well-known insect that damages cruciferous crops all over the world. Synthetic chemical pesticides have been an important tactic in the field of crop protection for the past 60 years, but their availability is currently decreasing due to the emergence of insect resistance. Alternative pest management methods are therefore required. However, the discovery of RNAi gene silencing in insects and its effective use in preventing the expression of essential genes paved the way for the advancement of a number of unique, ecologically friendly strategies for the control of insect pests.

INTRODUCTION

The Diamondback Moth (DBM), scientifically known as *Plutella xylostella* (L.), is a well-known insect that damages cruciferous crops all over the world. Failures in DBM management have been caused by the overuse of chemically synthesised insecticides as well as the use of biopesticides like *Bacillus thuringiensis*. Ribonucleic acid interference (RNAi), a more promising, non-chemical, and safe method must be used to overcome this problem.

Figure 1. Dimond back moth (*Plutella xylostella)damage on cabbage*

All animals have acetylcholinesterase (AChE, EC3.1.1.7) at the synapses of cholinergic neurons in the central and peripheral nervous systems. It is necessary for ending neurotransmission by catalysing the hydrolysis of the neurotransmitter acetylcholine (ACh). Both organophosphate and carbamate insecticides have been developed to control a variety of insect species, including the diamondback moth (DBM), *Plutella xylostella*, based on the method of blocking AChE. (Lepidoptera: Plutellidae). The most devastating pest of cruciferous vegetables, notably cabbage, is dimond back moth, due to their ease of use and affordability, chemical pesticides continue to be the primary method of controlling *P. xylostella*. Unfortunately, since the 1980s, enormous amounts of organoposphate and carbamate pesticides have been used continuously, and this has resulted in *P. xylostella* developing considerable insecticide resistance (Grzywacz *et al.*, 2010). In addition, recent studies show that some *P. xylostella* populations have developed resistance to practically every class of chemically synthesised pesticide used in the field, including organophosphates, carbamates, pyrethroids, spinosyns, avermectins, neonicotinoids, pyrazoles, and oxadiazines (Santos *et al.*, 2011). In order to solve the existing challenges, it is vitally necessary to develop novel insecticidal chemicals. In many eukaryotes, including insects, downregulating gene expression is possible due to the evolutionarily conserved genetic control mechanism known as RNA interferenceRNAi(Jinek and Doudna, 2009).

RNAi technology

RNA interference (RNAi) is the sequence-specific downregulation of cognate genes mediated by endogenous or exogenous introduction of double-stranded RNA (dsRNA). Small interfering RNAs (siRNAs), which are formed from the dsRNA by the activity of the dsRNA-specific endonuclease known as Dicer, are used to facilitate this degradation (RNaseIII). Double-stranded RNA (dsRNA) induces RNAi, a reverse genetic technique with excellent sequence specificity, to silence the target genes. This study's goal was to mute two DBM candidate genes, Ecdysteroid receptor (PxEcR) and Juvenile Hormone Epoxide Hydrolase (PxJHEH), which regulate moulting and metamorphosis, respectively. In this regard, they used custom designed dsRNAs (500bp) and by cloning and sequencing the candidate genes and delivered it orally (non-invasive mode). Further, they assessed the extent of down regulation of target genes with five concentrations of dsRNA (1, 2, 5, 10 and 20µg/µl) at four time points (24, 48, 72 and 96h). The extent of gene silencing and mortality recorded for both genes were proportional to the dsRNA concentration (Chaitanya *et al*., 2017). Improvements are required, although this technology has recently been employed to produce new biological insecticides. According to Gong *et al*. (2011), chemically manufactured siRNA at a concentration of 3.0 µg cm−2 caused 73% of *P. xylostella* to death, indicating the potential application of chemically synthesised and modified siRNA as a novel bio-pesticide in the near future.

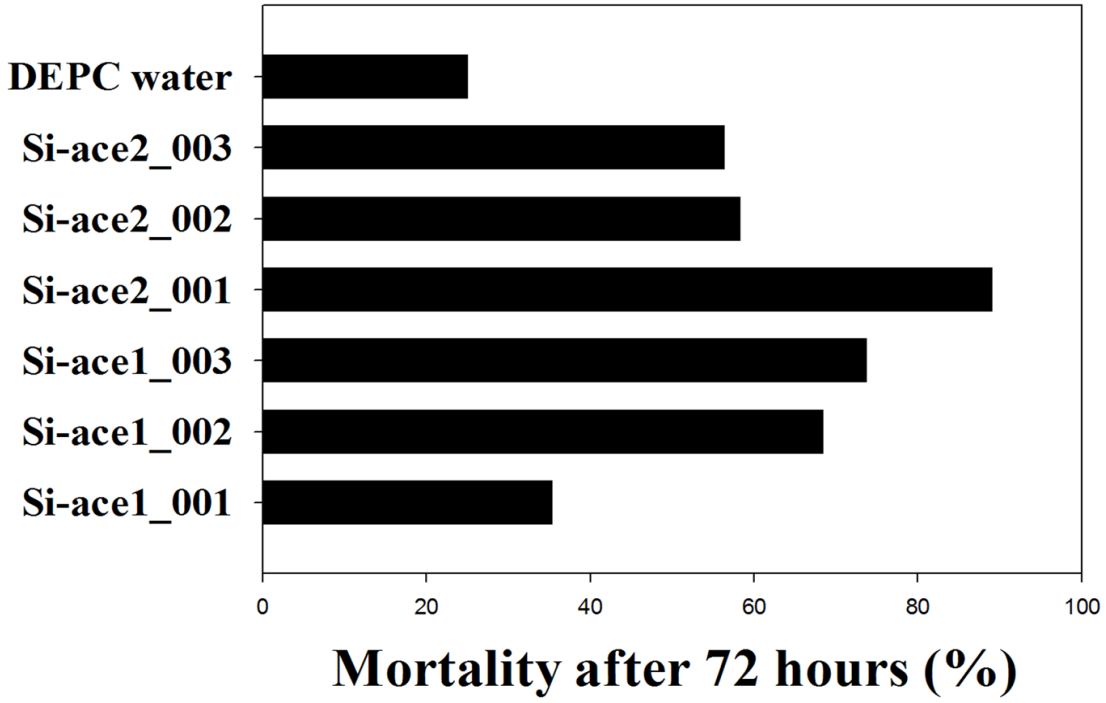

Figure 1. Mortality caused by chemically synthesized siRNA against second-instar larvae of *Plutella xylostella*, assessed by feeding test after 72 hour(Gong *et al*., 2013).

Two *P. xylostella* AChE genes were targeted by chemically synthesized siRNAs. We detected that Si-ace2_001which had the highest insecticidal effectiveness, causing 89% mortality at 72 h after exposure (Figure1).

CONCLUSION

Recent research has demonstrated the potential of RNAi in the control of insect pests. However, the field-level application of the RNAi approach for pest control is still in its early stages. By identifying the crucial genes, altering their expression in a way that will make it more difficult for insects to survive, and designing plants to create dsRNA molecules against those target genes, this issue could be solved. Many insect species, including the economically significant insect pests, are being sequenced. The availability of these insects' whole genome sequences aids in a better understanding of the RNAi machinery, the discovery of novel target genes, and the resolution of difficulties encountered when using the RNAi approach as a pest control strategy. This new information will make it easier to develop insect pest control strategies based on RNAi in the future and offer novel approaches to numerous ongoing and new issues relating to the management of insect pests.

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