Genetic Improvement of Natural Enemies

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ABSTRACT

Biological control is now recognized as an environmentally sound, technically appropriate, economically viable, and socially acceptable approach to pest control. The injudicious use of insecticides nowadays pose a threat to both the populations of target pests and beneficial insects.According to recent studies, IPM programs can be improved by establishing pesticide-resistant parasites that were chosen in the lab and then released into the field.The efficacy of natural enemies may be increased by a variety of characteristics, such as tolerance to pesticidal stress, tolerance to severe abiotic stressors, shortening developmental rate, an increase in offspring production, a change in the sex ratio, and a change in host or habitat preferences.Development of 'lab creatures' with improved traits through molecular methods can enhance their efficiency thereby providing assured rates of pest control. Hence, we should utilize the emerging techniques in the field of molecular biology so that 'farmers' friends' can be successfully manipulated in the process of pest management.

Key words:Biological control, IPM, natural enemies, pesticide, pest management

Introduction

The efficacy of natural enemies (pathogens, parasitoids and predators) was being genetically enhanced through the adaptation of many technologiesviz., artificial selection of a variety of strains under different conditions, hybridization (heterosis) of diverse strains, and the use of rDNA technology. Various traits like tolerance to pesticidal stress, tolerance to extreme abiotic stresses, shortening developmental rate, enhancing progeny production, altering sex ratio, and altering host or habitat preferences could enhance the effectiveness of natural enemies. Genetically improved natural enemies (predators, parasitoids, and pathogens) might become the next level biological weapons against the pest populations in agricultural systems (Routrayet al., 2016).

Genetic improvement projects with natural enemies of insects have been conducted for:

- Improved climatic tolerances
- Improved host finding ability
- Changes in host preference
- Improved synchronization with the host
- Insecticide resistance
- Evolution of Non-diapausing natural enemies
- Induction of thelytokous reproduction.

Methods employed for the improvement of natural enemies.

1. Conventional approaches

a. Artificial selection:

Artificial selection, often known as selective breeding, is the process by which a breeder choosesthe individuals exhibiting aparticular desired inheritable traits. Artificial selection in the laboratory is utilizedfor temperature and insecticide resistance.

Successful examples:Trichogrammachiloniswasgenetically improvedto tolerate three major groups of

insecticides endosulfan (organochlorines), monocrotophos (OP) and fenvalerate (synthetic pyrethroids) and high tempretures of 32-38ºC(Routrayet al., 2016).Endosulfan tolerant strain of T. chilonisis marketedunder the name 'Endogram'. The predatory mite Metaseilusoccidentalisaquired resistance to organophosphates (OP) through field selection (Routrayet al., 2016).Monocrotophos resistant strain of Chrysoperlacarneashowed a cross resistance to other insecticidesviz.,dimethoate, acephate, phosphomidon and methyl-demeton (Patel and Yadav, 1995).

High temperature tolerant Trichogramma

- It has been reported that the survival and ability of T. chilonisto parasitise decreases with increases in the temperature higher than 32°C (Jalali and Venkatesan, 2005).

b. Hybridization

Hybridization is the process of crossing two genetically distinct individuals belonging to the same species (intraspecific hybridization) or different species (interspecific hybridization).Interspecific hybrids of Chrysoperla with increased fertility were developed by Naka et al. (2005)by crossing between green lacewings of indigenous origin, C. carneaand that introduced ones from Germany, C. nipponensis.

2. Molecular approaches

Recombinant DNA (rDNA) technology

Recombinant DNA (rDNA) technology or genetic engineering refers to the artificial synthesis or isolation of specific genes or DNA fragments and introducing these into the genome of host organism.Invector-mediated method, vectors like plasmids and bacteriophages help in carrying and integrating the desired gene into the genome of the host.

DNA sequencing in predatory mite M. occidentalis:

Hoy(2009) reported that this predator contains multiple genomes,including the genomes of several microbial symbionts aswell as its own mitochondrial and nuclear genomes. By creating strains of this predator that were resistant to various pesticides, could not overwinter in diapause, and could be genetically altered through the use of recombinant DNA, it was genetically enhanced for use in agriculture. Nuclear genome sequencing would yield insightful information that could aid genetic enhancement initiatives.

Genetic transformations can be deployed in natural enemiesto

- Modify the genome of natural enemies
- Change the sex ratio
- Cryopreservation
- Develop genetic linkage maps
- Identify biotypes
- Improve artificial diets
- Monitor establishment and dispersal
- Parentage analysis and genetic changes

National authorities dealing in GMO's

- RDAC- Recombinant DNA Advisory Committee
- IBSC- Institutional Biosafety committee
- RCGM- Review Committee on Genetic Manipulation
- GEAC - Genetic Engineering Approval committee
- SBCC-State Biotechnology coordination committee

- DLC- District Level Committee

Conclusion

We should have a definite and distinct knowledge on various factors affecting the sustenance of natural enemies, which act in the ecosystem. Various molecular methods can be used for the manipulation of natural enemies with recombinant DNA technology standing in the forefront. Development of 'lab creatures' with improved traits through molecular methods can enhance their efficiency thereby providing assured rates of pest control. Hence, we should utilize the emerging techniques in the field of molecular biology so that 'farmers' friends' can be successfully manipulated.

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