Variation in sexual communication and its role in divergence of two host strains of the noctuid moth Spodoptera frugiperda

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Summary

The main aim of my research was to determine the level and importance of strain-specific sexual communication as prezygotic isolation barrier in *Spodoptera frugiperda*. Specificially, the first aim was to evaluate whether strain-specific sexual communication acts as prezygotic mating barrier between corn- and rice-strain populations and contributes to reproductive isolation between both strains. The results of our studies showed that differences in the sexual communication system of both strains are probably not strong enough to cause assortative mating in the field (Chapter 2), which suggests that sexual communication is a weak prezygotic mating barrier between both strains, at least in Florida. However, our data also indicate that the sexual communication system of *S. frugiperda* varies between North- and South America (Chapter 3), and thus we cannot exclude that sexual communication might play an important role in strain divergence in some regions. Therefore, more research, especially in regions in the Caribbean and South America, will be needed to rule out that strain-specific sexual communication alone is not capable of driving divergence between the two *S. frugiperda* strains.

The second objective of this thesis was to differentiate strain-specific variability in the male response from geographic variation that might influence both strains. We studied the response of corn- and rice-strain males in different geographic regions and found that geographic variation interferes with strain-specific variation, at least in the corn-strain (Chapter 3). In contrast, we found almost no geographic variation in the response of rice-strain males (Chapter 3). However, in most regions, we tested only a limited set of different synthetic pheromone blends, and E7-12:OAc, which seems to be important for the attraction of *S. frugiperda* males in South America, was not part of our strain-specific female pheromone blends (Chapter 3). More studies on the response of males towards different doses of E7-12:OAc in different regions are required because it is still unclear whether males of both strain

differ in their response to E7-12:OAc. Furthermore, additional pheromone analyses of females from different regions should be performed, with the aim to prepare synthetic pheromone lures that mimic a specific regional strain-specific female pheromone blend. Testing such regional synthetic pheromone lures to attract males in the field could help to further disentangle geographic from strain-specific variation in the corn- and the rice-strain. Besides additional information to understand the evolution of both strains, further research might also help to improve pest management of *S. frugiperda* in different regions.

The third aim of this thesis was to examine the genetic basis and inheritance of strain-specific corn- and rice-strain female pheromone blends. We conducted a QTL analysis and found that multiple genomic regions are involved in the production of strain-specific pheromone blends (Chapter 4). A delta-11-desaturase (*Sf*LPAQ) could be involved in the strain-specific production of the major pheromone component Z9-14:OAc and the minor compound Z11-16:OAc (Chapter 4). Interestingly, we found a possible genetic link between pheromone production of Z7-12:OAc and strain-specific timing of reproduction in the night, via the circadian clock protein *vrille* (Chapter 4). Additional genetic studies could help to understand whether a possible genetic coupling of different reproductive isolation mechanism exists and facilitates the divergence of corn- and rice-strain populations in different regions. Genetic studies on the response of corn- and rice-strain males will be useful to determine if a possible linkage between different prezygotic mating mechanisms, i.e. the pheromone response and the strain-specific reproductive activity of males, also exist in males.

The results of this thesis suggest that strain-specific sexual communication alone is not sufficient to prevent hybridization between both strains in the field, although is seems that sexual communication might act together with other prezygotic

reproductive isolation barriers like strain-specific host choice and differential timing of mating in the night (Chapter 5 and 6). Interactions between these different prezygotic mating barriers, together with one postzygotic isolation mechanism, i.e. the reduced mating success of RC hybrid (rice-strain♀ x corn-strain♂) females, seems to prevent both strains from merging into one mixed populations and thus preserves strain-identity of both *S. frugiperda* strains (Chapter 5 and 6). However, hybridization between both strains exists and more research will be required to estimate how differentiated and separated both strains are in different regions. Area-wide studies on all different pre- and post-zygotic isolation mechanisms found so far will help to understand the strength and interactions of different isolations barriers in *S. frugiperda* in North and South America. So far, it seems that both strains are mainly separated by the strain-specific timing of reproduction and the partial sterility of RC hybrid (rice-strain♀ x corn-strain♂) females, and less so by strain-specific sexual communication via sex pheromones (Chapter 5 and 6). However, none of these isolation barriers alone are likely to explain the divergence between the two strains of *S. frugiperda*. Therefore, these two sympatrically occurring strains are a good model system to study how the evolution of ecological divergence interacts with the evolution of sexual communication.