THE SCIENCE WORLD
A Monthly e Magazine
ISSN:2583-2212
Oct, 2023; 3(10), 2567-2569

Popular Article

Butterflies eyespot

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https://doi.org/10.5281/zenodo.10010527

Introduction

Colour pattern in butterfly wings is a kind of mosaic pattern of dozens to hundreds of finely-tiled monochromatic scale cells. Colour pattern formation occurs in a single layer of the wing disc and it is essentially two-dimensional in space without cell movement. The eyespots, however, form in response to epidermal cell interactions that occurred much earlier in development. Butterfly wing patterns are not just unique arrangements of pigmentation rather they share relatively few pattern elements. That is, most butterflies have colour patterns composed of discrete pattern elements whose homology can be traced across genera and family. The system of homologies among pattern elements is now called the nymphalid ground plan (NGP). Thus, butterfly wing pattern evolution is based on nymphalid ground plan. Butterfly wing patterns comprise a series of symmetry systems showing several bands like basal and central bands, border ocelli (light red), parafocal elements, sub marginal and marginal bands. Monteiro (2015) defines eyespots as colourful, conspicuous and concentric circular markings on the margin of wings that butterflies mostly of the family Nymphalidae possess. Eyespots within a single individual can have different morphologies and vary between males and females. Species often differ in the location where these eyespots are displayed; in the total number of eyespots; and in their size, colour, and number of rings.

Eyespot development

Surveys for the expression of a few candidate genes during the larval stage of wing development in nymphalid species with eyespots found that at least two genes (spalt and Distal - less) were expressed in most eyespot centers (Oliver *et al*., 2012). So far, a variety of candidate genes with expression in the eyespot field have been identified, but only two genes have been tested at the functional level. One of the genes tested codes for the transcription factor *Distal-less* (Dll), and the other gene codes for the ligand *Hedgehog* (Hh). The *Distal-less* gene is present in almost all eyespot

organizers, making it an ideal candidate to carry out major functions of eyespot formation. During the wing imaginal disc development Dll, has two expression domains separated by a temporal component. First Dll is expressed in a group of cells in the center of what will become the focus and eventually the eyespot. This expression starts during the middle of the fifth instar larvae and lasts until the pupal stage. The second domain starts around 20 hours after pupation around the original central cluster of cells, in an area in which a black ring of the eyespot will be formed. The wide distribution of Dll across eyespot forming butterflies suggest that this transcription factor is a central regulator for the correct patterning of the eyespots (Monteiro, 2015). Eyespots develop around a small central region, focus act as an organizer to specify eyespot (Nijhout, 1980). Focus is the discrete organizing centre. Organizing centres are specialized group of cells that occur at various locations on wing surface and wing margin (Nijhout, 1980). Surgical experiments, pioneered by Nijhout (1980), showed that the eyespot rings are specified on early pupal wings by signals coming from the central focus. Thus,

Butterflies with eyespots

Blue pansy

Oxeoschistus puerta

Clipper

Grey pansy

Elephant hawk moth

Official Website
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Published: 15.10.2023

removal of the focal cells eliminates the eyespot, while grafting them elsewhere on the wing epidermis produces a displaced eyespot pattern. Eyespot is specified by a signal from the focus. This signal is an unstable and diffusible molecule called morphogen. Focus is the source of a morphogen that is somehow able to induce synthesis of specific pigments.

References

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