

Characterizing Toll 6-2 Receptor expression in developing *Gryllus bimaculatus* embryos

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Neuroplasticity—the ability of the nervous system to adapt after injury—is essential for learning, memory, and recovery. While mammals have limited ability for neural repair, the cricket *Gryllus bimaculatus* demonstrates remarkable plasticity. After injury, certain auditory neurons in the cricket's prothoracic ganglion (PTG) can sprout new connections across the midline, which is a well-defined feature that neurons do not normally cross. This makes *G. bimaculatus* a valuable model for studying how neurons regenerate and rewire.

I examined the role of the Toll 6-2 receptor, which is part of the Toll-Spätzle signaling pathway. This pathway is known to influence neuronal growth and remodeling in invertebrates. Understanding its functions may reveal molecular mechanisms similar to human neurotrophins such as NGF and BDNF, which are critical for neuronal survival and plasticity. I focused on three tissues: the brain, because it is highly plastic and constantly forming new neural connections; the PTG, because past research suggests that Toll 6-2 is increased after injury and may help guide auditory neurons during regeneration; and embryos, because their rapid developmental changes require a high degree of neural plasticity.

To investigate Toll 6-2 expression, I used hybridization chain reaction (HCR), an advanced technique for detecting mRNA. I applied HCR to dissected crickets' brains, PTGs and embryos throughout different developmental stages. These tissues were imaged using fluorescent confocal microscopy to visualize where Toll 6-2 was expressed.

Results revealed clear expression patterns of Toll 6-2 in *G. bimaculatus*. In the brain, Toll 6-2 was strongly expressed in the mushroom bodies—regions involved in learning and memory, comparable to the hippocampus in humans. In the PTG, Toll 6-2 expression was variable, but when present, it appeared in distinctive clusters around the midline, which could indicate Toll 6-2 role in rerouting auditory neurons across the midline. In embryos, Toll 6-2 showed horizontal striped expression across the body, antennae, and centralized expression in the head, highlighting its role in the rapid neuronal growth that occurs during embryonic development.

By mapping these expression patterns, this study provides new insights into how Toll receptors may contribute to neuronal plasticity. Future research to determine the cause of the variable expression in the PTGs would help determine the Toll 6-2 receptors' exact role in neuroplasticity in *G. bimaculatus*. These findings not only advance our understanding of regeneration in crickets but could also inform future approaches to neural repair in humans.

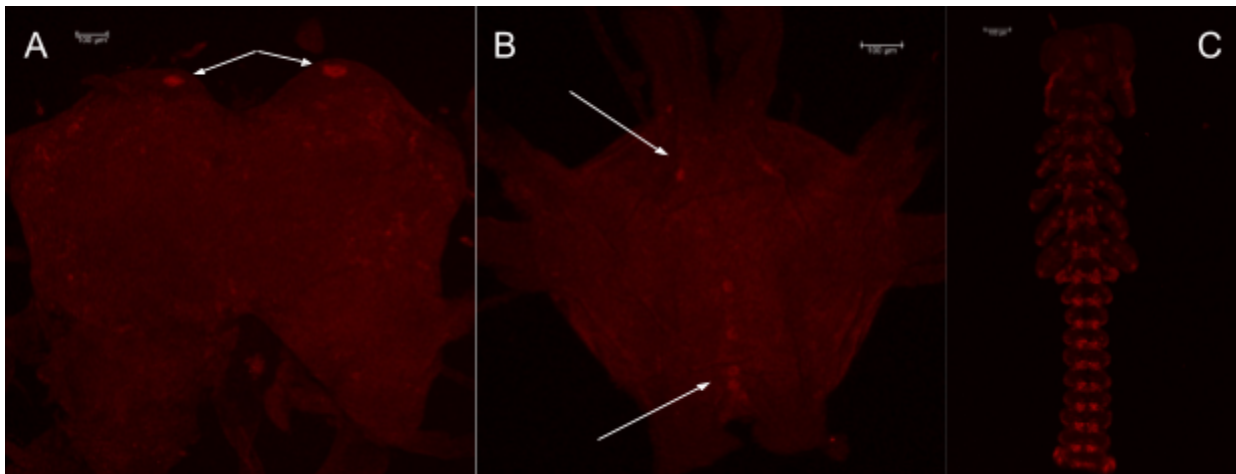


Figure 1. Toll 6-2 Hybridization Chain Reaction Tissue. A is a brain, B is a PTG, and C is an embryo.

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