

Posterior localization of ApVas1 positions the preformed germ plasm in the sexual oviparous pea aphid *Acyrtosiphon pisum*

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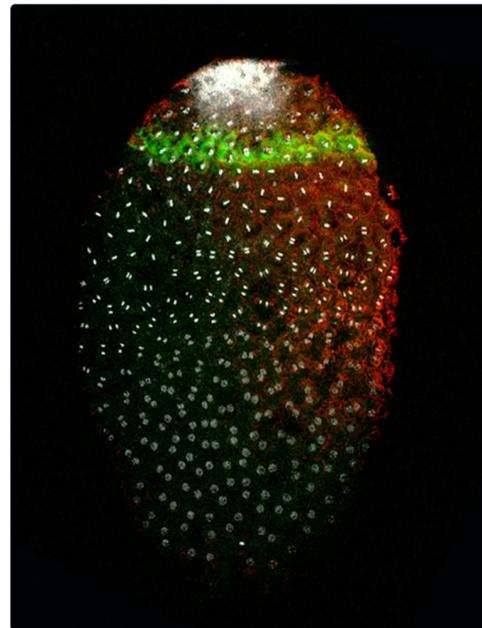
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Abstract

Background: Germline specification in some animals is driven by the maternally inherited germ plasm during early embryogenesis (inheritance mode), whereas in others it is induced by signals from neighboring cells in mid or late development (induction mode). In the Metazoa, the induction mode appears as a more prevalent and ancestral condition; the inheritance mode is therefore derived. However, regarding germline specification in organisms with asexual and sexual reproduction it has not been clear whether both strategies are used, one for each reproductive phase, or if just one strategy is used for both phases. Previously we have demonstrated that specification of germ cells in the asexual viviparous pea aphid depends on a preformed germ plasm. In this study, we extended this work to investigate how germ cells were specified in the sexual oviparous embryos, aiming to understand whether or not developmental



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Lin *et al.*



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plasticity of germline specification exists in the pea aphid.

Results: We employed *Apvas1*, a *Drosophila vasa* ortholog in the pea aphid, as a germline marker to examine whether germ plasm is preformed during oviparous development, as has already been seen in the viviparous embryos. During oogenesis, *Apvas1* mRNA and ApVas1 protein were both evenly distributed. After fertilization, uniform expression of *Apvas1* remained in the egg but posterior localization of ApVas1 occurred from the fifth nuclear cycle onward. Posterior co-localization of *Apvas1*/ApVas1 was first identified in the syncytial blastoderm undergoing cellularization, and later we could detect specific expression of *Apvas1*/ApVas1 in the morphologically identifiable germ cells of mature embryos. This suggests that *Apvas1*/ApVas1-positive cells are primordial germ cells and posterior localization of ApVas1 prior to cellularization positions the preformed germ plasm.

Conclusions: We conclude that both asexual and sexual pea aphids rely on the preformed germ plasm to specify germ cells and that developmental plasticity of germline specification, unlike axis patterning, occurs in neither of the two aphid reproductive phases. Consequently, the maternal inheritance mode implicated by a preformed germ plasm in the oviparous pea aphid becomes a non-canonical case in the Hemimetabola, where so far the zygotic induction mode prevails in most other studied insects.

Keywords: Aphid, Asymmetric localization, Developmental plasticity, Germ cells, Germline specification, Vasa

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