Studies on Interaction and Chemical Communication between Aphids, Ants and Natural Enemies

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Abstract

Partner discrimination is crucial in mutualistic interactions between organisms to counteract cheating by th partner. Trophobiosis between ants and aphids is a model system of such mutualistic interaction. To establ and maintain the mutualistic association, ants need to correctly discriminate mutualistic aphids. However, th mechanism by which ants recognize aphids as their partners was poorly understood, despite its ecological and evolutionary importance. We showed that aphid recognition by workers of the ant *Tetramoriu tsushimae* depends on learning [1]. When ants had previously tended the cowpea aphid, *Aphis craccivora*, they moderate their aggressiveness toward the aphids. In addition, our results of behavioral assays and chemic analyses showed that ants use cuticular hydrocarbons of aphids for partner discrimination. Ants especiall use methylalkanes of the mutualistic aphid's hydrocarbons to recognize partners. Moreover, ants that had interacted with aphid-experienced nestmates also reduced their aggressiveness toward aphids, even thou they had never directly experienced them, indicating that aphid information was transmitted from aphid-experienced ants to inexperienced ants [2]. Inhibition of trophallaxis from aphid-experienced ants to inexperienced ants caused the inexperienced ants to become aggressive toward aphids, suggesting that ants transfer information on their mutualists during trophallactic interactions. These partner recognition system depending on self-learning and information transmission would allow ants to rapidly establish and maintain mutualistic relationships with aphids and avoid cheating by aphids.

Although ants usually attack and exclude natural enemies of aphids in ant–aphid mutualisms, some enemies such as larvae of the green lacewing, *Mallada desjardinsi*, prey on aphids without exclusion by aphid-tending ants. Lacewing larvae are protected from ants by carrying aphid carcasses on their backs. We showed that aphid carcasses provide physical protection and attenuate ant aggression toward lacewing l on aphid colonies. Since cuticular hydrocarbon profiles of aphid carcasses on the backs of lacewing larv were similar to those aphids, aphid carcasses function via chemical mimicry to limit attacks by aphid-tending ants. Natural enemies that consume aphids without exclusion by aphid-tending ants gain benefits that reduce the risk of predation indirectly by these associations.

References

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