Anaphylaxis due to Hymenoptera stings is one of the most severe consequences of IgE-mediated hypersensitivity reactions. Although allergic reactions to Hymenoptera stings are often considered as a general model for the underlying principles of allergic disease, diagnostic tests are still hampered by a lack of specificity and venom immunotherapy by severe side effects and incomplete protection. In recent years, the knowledge about the molecular composition of Hymenoptera venoms has significantly increased and more and more recombinant venom allergens with advanced characteristics have become available for diagnostic measurement of specific IgE in venom-allergic patients. These recombinant venom allergens offer several promising possibilities for an improved diagnostic algorithm. Reviewed here are the current status, recent developments, and future perspectives of molecular diagnostics of venom allergy. Already to date, it is foreseeable that component-resolution has now or will in the future have the potential to discriminate between clinically significant and irrelevant sensitization, to increase the specificity and sensitivity of diagnostics, to monitor immunotherapeutic intervention, and to contribute to the understanding of the immunological mechanisms elicited by insect venoms.