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Olfactory modulation of honeybee aggressiveness

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Aggression is an innate behaviour and a crucial element in the competition for food, mates and territory as well as a defence mechanism against predators. The defensive behaviour of the honeybee *Apis mellifera* aims at the protection of its nest, which contains the food, brood and the only reproductive individual of the colony, the queen. Despite the common use of this insect as a model in neuroscience, few studies have investigated to date the neural and molecular bases of its aggressive behaviour. One possible reason for this was the lack of a reliable assay to assess the individual aggressiveness of bees under controlled laboratory conditions. Here we introduce a novel, arena-based assay that successfully induces bees to sting in a context different from that of the hive defence. Importantly, this assay triggers stinging responses using jerky movements and dark colour of the target rather than electric shocks, thus providing conditions very similar to the ones naturally experienced by the bees. We then used this assay to investigate whether plant odours or pheromonal compounds modulate aggression in the honeybee, when presented alone or along with the major alarm pheromone component isopentyl-acetate (IPA). We show that three plant odours (linalool, 2-phenylethanol and to a lesser extent lavender) significantly reduce the bees' responsiveness to IPA, even at very low concentrations (10% IPA vs 0.075% plant odours). We also show that citral, an attractive pheromonal component released at the hive entrance, slightly increases the chances of an attack. Using an odour-conditioning assay, we further checked that plant odours do not simply 'mask' IPA when presented together. This suggests that the effect of plant odours may be due to their potential alteration of IPA processing in the olfactory system. Our results highlight the crucial role olfaction plays in eliciting and controlling aggressive behaviour in bees.