

Honest signalling and the billboard effect: how Heliconiid pollinators respond to the trichromatic colour changing *Lantana camara* L. (Verbenaceae)

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Plants are usually stationary and have a problem getting together for sexual reproduction. Thus, many use a wide range of shapes, colours, and/or odours as signals to bribe animals to move pollen (male sex cells) to stigmas (receptive female surfaces) of similar species of plants. Furthermore, these floral attractants can be either honest or deceptive. In honest attractants, plants offer something of value, usually food rewards, to their go-betweens known as pollinators. Honest signals can involve both vegetative and reproductive parts of flowers.

Colour signals are of particular importance to pollinators as they are able to perceive and differentiate among colours and are able to associate colours with rewards. Therefore, many plants use colour as an honest signal to reliably indicate the presence of a reward, such as nectar, which bribes pollinators. Some plants even change colour to provide additional information to pollinators of reward availability. For example, pre-change flowers are often rewarding and have receptive stigmas, while post-change flowers offer little or no rewards and are sexually inviable.

We examined the relationships among floral colour changes, nectar volume, and sugar concentration in wild type sweet sage, *Lantana camara*, on pollinator visitation and fruit-set at CEIBA Biological Center, Madewini, Guyana.

We found that butterflies visited pre-change yellow flowers that offered higher quality and greater quantities of sucrose rewards



Heliconius melpomene feeding on nectar and pollen bribes produced by *Lantana camara* flowers. Photo credit: Godfrey R. Bourne

than post-change orange, or red flowers. We also found that natural bunches of flowers, inflorescences, with higher ratios of rewarding pre-change flowers to post-change unrewarding flowers were more attractive at short distances, i.e., butterflies visited many inflorescences on one plant. While inflorescences with a combination of pre-change and post-change flowers acted as multi-coloured advertising billboards, and were most attractive at long distances, i.e., they attracted the most visitors but these usually visited only single inflorescences. Further, butterfly visitation contributed to most of the fruit-set. Yet, was surpassed by a combination butterfly, bee, wasp, ant, and hummingbird visited flowers. We therefore, concluded that sweet sage profited by attracting many different types of pollinators through honest signalling about the availability of food rewards, by using its multi-coloured inflorescences to produce a billboard that was easily perceived and deciphered.