

# Lethality of 'killer' bee stings

SIR—It has been predicted that Africanized honeybees (*Apis mellifera scutellata*) will displace European honeybees in warm climate areas of the United States after 1989 (ref. 1). In South and Central America, the highly developed colony defences of Africanized honeybees include a predilection for mass attack

lethalities of the two venoms were calculated (as  $LD_{50}$ )<sup>12,13</sup> from experiments in which Swiss mice and C3H/OuJ mice weighing 20–30 g were injected with venom in doses of 1, 2, 4 and 8 mg per kg, with eight animals per dose.

As shown in the table the lethality of the two venoms was not significantly different

Lethality of Africanized and European honeybee venoms in two strains of mice

	$LD_{50}$ i.v. (mg per kg)	95% confidence interval	$LD_{50}$ i.p. (mg per kg)	95% confidence interval
Swiss mice				
Africanized bee venom	2.8	2.0–4.1	2.8	2.0–4.1
European bee venom	2.8	2.0–4.1	3.8	2.2–6.4
C3H/OuJ mice				
Africanized bee venom	7.1*	5.7–8.8	ND	
European bee venom	4.6*	3.6–5.7	ND	

ND, not done.

\* Significantly different,  $P < 0.001$ .

during which thousands of stings may be inflicted on one individual<sup>2–3</sup> causing life-threatening toxic reactions<sup>4–9</sup>. Although attacks of 300–500 stings have been survived without treatment<sup>4</sup>, more than 500 stings are commonly fatal<sup>8</sup>. Strategies for minimizing the severity of reactions to Africanized bee sting attacks require information on the toxicity and quantity of the venom of Africanized honeybees. We report such data and conclude, by comparison with data from European bees, that the mortality associated with Africanized honeybee attacks is primarily the result only of the number of stings.

Worker (forager) honeybees (mainly *Apis mellifera ligustica*) were captured while returning to their hive in Tucson, Arizona. Attacking Africanized honeybees were captured from a colony in Guanacaste, Costa Rica<sup>10</sup> and identified by two independent morphometric determinations (H. Daly, University of California, Berkeley; S.W. Batra, Smithsonian Institution, Washington). Venom, free from contaminants, was obtained from the venom reservoirs by dissection as previously described<sup>11</sup>, then lyophilized and stored at  $-20^{\circ}\text{C}$ .

Analysis of venom pooled from 1,000 bees of each type showed that European bees contained more venom (147  $\mu\text{g}$  dry weight) than Africanized bees (94  $\mu\text{g}$ ), which were also smaller in size. The

in Swiss mice challenged intravenously (i.v.) or intraperitoneally (i.p.), whereas Africanized bee venom was significantly less active than European bee venom in C3H/OuJ mice challenged intravenously.

As the venoms from the two types of honeybee are of similar lethality, and as there is less venom in Africanized honeybees, the serious effects of multiple stings from Africanized honeybees seem mainly to be attributed to the multiplicity of stings. Perhaps use of the popular term 'killer bee' to describe the Africanized bee is inappropriate.

MICHAEL J. SCHUMACHER

Department of Pediatrics,  
University of Arizona Health Sciences  
Center,  
Tucson, Arizona 85724, USA

JUSTIN O. SCHMIDT

Center for Separation Science,  
University of Arizona,  
Tucson, Arizona, USA

NED B. EGEN

Carl Hayden Bee Research Center,  
US Department of Agriculture,  
Tucson, Arizona, USA

## Sexual advantage

SIR—Kelley *et al.*<sup>1</sup> report a 1.43-fold advantage for sexual over asexual reproduction in sweet vernal grass and thus seem to answer the question of "the ubiquity of sex." However, we find several problems in their methodology and analysis of the data.

First, in an attempt to simulate the natural dispersal pattern of the offspring, Kelley *et al.* planted sexual and asexual progeny conforming to the seed dispersal pattern around the parent. This is erroneous for two reasons. (1) Asexual progeny (tillers) are generally conjoint with the parents and do not disperse as widely as seeds. Planting asexual tillers in a pattern conforming to that of seed dispersal will

grossly overestimate their fitness as it relieves them from competition for resources from the parent plant and also provides liberal space for the daughter tillers to sprout. (2) The natural pattern of distribution of the seedlings surviving to the age at which the authors transplanted the 'test' seedlings would be different from that of seed dispersal around the parent. Although the number of progeny is calculated, this is not used to arrive at the pattern of seedling distribution. Even if it had been, the failure to incorporate data on density-dependent germination and seedling survivorship at various distances from the parent would weaken the analysis. We believe that the planting pattern followed is very unnatural, and that the fitness estimates obtained are therefore incorrect.

Second, the relative advantages of sexual and asexual reproduction was compared using the number of inflorescences produced by the respective ramets. It denies logic to suggest that asexually reproducing organisms gain fitness through organs involved in sexual reproduction such as inflorescences and spikelets. A valid method could be to compare the number of tillers produced by asexually reproducing ramets with that of equal-aged seedlings produced from the total spikelets of the sexually reproducing ramets. Clones of purely sexual and asexual types would be needed for such a comparison, but unfortunately they are not found in sweet vernal grass.

Third, the authors attempt to test "spatially varying environment as a selective force favouring sex" by comparing the relative fitness of the sexual over asexual reproduction for a 2-m distance from the parent. We do not think that the 2-m range is sufficient to represent a spatially varying environment; nor are we provided with any index of environmental variation within this 2-m radius around the parent plant.

Finally, the degrees of freedom for parents in Table 1 of ref. 1 should be 24 rather than 25.

R. UMA SHAANKER

K.N. GANESHAIAH

Departments of Crop Physiology and  
Agricultural Botany,  
University of Agricultural Sciences  
GKVK Campus,  
Bangalore 560 065, India

KELLEY *ET AL.* REPLY—Shaanker and Ganeshaiah seem to have misunderstood the purpose of our experiment. We intended to test the short-term advantage of sexual versus asexual reproduction, and not the advantage of seed versus vegetative propagation. Hence, we were interested in measuring the short-term selective force which would act against a mutant converting sexual to asexual seed production (if and when it arose). Both

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