ing and disease hosts for RVF in many parts of Africa (Davies 1975), although local farming practices often dictate whether sheep assume this role in some areas (Davies, unpublished data). These results suggest that *Aedes* mosquitoes, in this ecosystem *Ae. lineatopennis*, could play some role in the generation of epizootics of RVF. Rift Valley Fever virus has been isolated from *Ae. lineatopennis* in epizootics of RVF in Africa (McIntosh 1972, Davies and Highton 1980) and from *Ae. circumluteolus* (Gear et al. 1955). McIntosh et al. (1980) have demonstrated that *Ae. lineatopennis* transmitted RVF virus under laboratory conditions.

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GENETIC ANALYSIS OF A LINKAGE GROUP III MUTANT IN *ANOPHELES STEPHENSI*

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A new mutant short, curved palpus/proboscis (*scp*) was discovered during routine handling of a translocation strain, *T(2R;3R)4* (Sakai et al. 1983), of *Anopheles stephensi* Liston. The mutant is characterized by shortened (2/3–3/4 normal length) palpi and proboscis, both of which curve upward toward the dorsum of the adult. There is some variability in expression but penetrance is complete and both sexes express the mutation. A true-breeding *scp* strain, free of the translocation, was isolated and crosses were made to study the mode of inheritance of this mutation.

Preliminary crosses indicated that the mutation was recessive and autosomal as reciprocal crosses with a wild type (+) strain gave all + F_1 progeny whereas a sex-linked mutation in this species in which females are XX and males XY (Aslamkhan 1973) would have resulted in + ♀ and *scp* ♂ F_1 progeny in one of the crosses (*scp* ♀ x + ♂). Moreover, crosses with the chromosome 2 mutant marker, *mar* (Mahmood and Sakai 1982), indicated that *mar* and *scp* segregated independently of each other. Therefore, a series of crosses were initiated between the *scp* and *Bl* (black larva, a chromosome 3 mutant, Akhtar et al. 1982) strains. Table 1 summarizes the results and also contains the observed recombination frequencies between *scp* and *Bl*.

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Table 1. Crosses to elucidate the linkage relationship between *scp* and *Bl* in *Anopheles stephensi*.

Cross	Parental genotypes ♀		Parental genotypes ♂	f*	Progeny phenotypes ♀ +	♀ scp	♀ blk**	♀ scp blk	♂ +	♂ scp	♂ blk	♂ scp blk	Linkage chi-square scp-Bl	% recombination scp-Bl
1	+ scp / + scp	X	Bl + / Bl +	5	0	0	212	0	0	0	203	0	—	—
2	Bl + / Bl +	X	+ scp / + scp	8	0	0	387	0	0	0	341	0	—	—
3	+ scp / Bl +	X	+ scp / + scp	4	14	114	158	43	23	166	142	24	331***	15.20 ± 1.37
4	Bl + / + scp	X	+ scp / + scp	9	53	254	278	52	40	256	253	35	607***	14.74 ± 1.01
3+4		—		—	—	—	—	—	—	—	—	—	938***	14.91 ± 0.82
5	+ scp / + scp	X	+ scp / Bl +	4	20	80	101	36	26	83	86	22	133**	22.91 ± 1.97
6	+ scp / + scp	X	Bl + / + scp	6	35	133	132	53	54	124	130	20	187***	23.79 ± 1.63
5+6		—		—	—	—	—	—	—	—	—	—	320***	23.43 ± 1.26

* No. of families tested.
** An intermediate color between the + and *Bl* parents.
*** $P < 0.01$.

Crosses 1 and 2 are reciprocal crosses between the *scp* and *Bl* strains. All the F_1 progeny from both crosses were characterized by a body color intermediate between that of the wild type and *Bl* confirming Suguna's (1981) observation that *Bl* shows intermediate dominance. The palpi and proboscis of the F_1 progeny were normal in agreement with previous observations that *scp* is recessive. Crosses 3 and 4 are backcrosses of heterozygous F_1 females from crosses 1 and 2, respectively, to *scp* strain males and crosses 5 and 6 are the reciprocal heterozygous F_1 male backcrosses. No significant deviations from the expected 1:1 ratios for ♀:♂, +:*scp* or +:*Bl* were observed; however, highly significant chi-squares were observed for independent assortment between *scp* and *Bl*, indicating linkage between these two loci. The last column in Table 1 contains the observed recombination frequencies between *scp* and *Bl*. There is good agreement in the estimated frequencies of recombination between the two types of heterozygous female backcrosses and between the two heterozygous male backcrosses; however, there were significant differences between the estimates from female and male backcrosses. Thus, the pooled estimates for recombination between *scp* and *Bl* from the female backcrosses was 14.9±0.82% and from the male backcrosses was 23.43±1.26%. The reason for the differences in recombination frequencies between the female and male backcrosses is not known. Differences in recombination frequencies have also been observed by Seawright et al. (1984) with mutants on chromosome 2 of *An. albimanus* Wied.

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SOLUBILIZED CRYSTAL OF *BACILLUS THURINGIENSIS* SUBSP. *ISRAELENSIS*: EFFECT ON ADULT HOUSE FLIES, STABLE FLIES (DIPTERA:MUSCIDAE), AND GREEN LACEWINGS (NEUROPTERA: CHRYSOPIDAE)

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The specificity of the crystalliferous spore-forming entomopathogen *Bacillus thuringiensis* subsp. *israelensis* (H–14) for medically important larval dipterans, and the absence of its effects on non-target organisms, makes it an attractive biological control agent (Colbo and Undeen 1980, Davidson and Sweeney 1983). As with other subspecies of *B. thuringiensis*, most of the research on its pathogenicity to insects, with a few exceptions, has focused on the larval stage. However, it has been demonstrated that adult female *Aedes aegypti* (Linn.) mosquitoes are killed by the solubilized parasporal crystal of *B.t.i.* when the preparation is administered to adults as an enema, (Klowden et al. 1983) and oral ingestion also kills male and female adults of several mosquito species (Klowden and Bulla 1984). In order to determine the susceptibility of other adult insects to the solubilized parasporal crystals of *B.t.i.* we fed the preparation to adult stable flies, *Stomoxys calcitrans* (Linnaeus), adult house flies, *Musca domestica* (Linn.) and adults of the green lacewing, *Chrysoperla carnea* (Stephens).

Solubilized parasporal crystals of *B. thuringiensis* subsp. *israelensis* (H–14) were prepared as described by Klowden and Bulla (1984). Larval stable flies and house flies were reared in Purina larval medium (Ralston Purina Co.) at 27°C. Adult flies were maintained at 27°C and 80% RH with constant access to distilled water, but were denied a reproductive diet. Because the suction probe we used to manipulate mosquitoes (Klowden and Bulla 1984) was not effective with these larger insects, we lightly anesthetized the adult flies and attached them by the thorax to wooden applicator sticks using molten paraffin wax. When they recovered from the anesthesia, the flies were held under a dissecting microscope and were offered one microliter of several concentrations of the solubilized crystal containing 0.1% sucrose solution as a feeding stimulant. After they ingested the entire drop, the flies were removed from the sticks and incubated with access to 10% sucrose-soaked pads at 27°C for 48 hr. The brief period of restraint during experimental and control feedings and the small amount of paraffin that remained on the flies did not cause demonstrable trauma as evidenced by the negligible mortality in controls.

Larvae of the green lacewing were reared on a diet of pea aphids, (*Acyrthosiphon pisum* (Harris)), corn earworm eggs (*Heliothis zea* (Boddie)) or red flour beetle larvae (*Tribolium confusum* Jacquelin duVal) depending upon availability. After pupation the cocoons were individually placed into test tubes and maintained at 27°C and 80% RH. After emergence, while held by the wings with forceps, adults were offered 1 microliter of *B. thuringiensis* subsp. *israelensis* (H–14) solubilized crystal. After the entire drop was ingested the insects were placed in small cages with cotton pads soaked with 10% sucrose and incubated at 27°C for 48 hr. Controls in all groups were fed identical preparations that were heat inactivated in a boiling water bath for 5 min. Mortality was determined at 48 hr after ingestion of the *B. thuringiensis* subsp. *israelensis* (H–14) preparations.

The results in Table 1 indicate that adult house flies and lacewings were not susceptible to the solubilized parasporal crystals of *B. thuringiensis* subsp. *israelensis* (H–14) at the dosages administered. This contrasts with the re-

Table 1. Effect of solubilized parasporal crystals of *B. thuringiensis* subsp. *israelensis* (H-14) on the survival of house flies, stable flies, and green lacewings at 48 hr. after ingestion.

Species	Dose (μ/insect)	No. tested	% mortality
Musca domestica	1.3	101	5
females	2.6	117	5
	2.6*	82	0
Stomoxys	1.2	83	12
calcitrans	2.6	94	50
females	2.6*	48	10
Stomoxys	1.2	20	5
calcitrans	2.5	155	68
males	2.5*	51	3
Chrysoperla	2.8	11	0
carnea males	2.8*	6	0
Chrysoperla	2.8	12	0
carnea females	2.8*	6	0

* Heat-inactivated.