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Background

Adaptation to a new host plant can alter an insect's pest status and geographic range, and might promote speciation. We used experimental evolution to examine the consequences of adaptation to a very poor host (lentil) in replicate lines of seed beetles.

First, we asked whether colonization of a novel host reduces performance (larval survival or host acceptance) on the ancestral host, perhaps because of genetic trade-offs between hosts. Such trade-offs could account for the narrow host ranges of insect herbivores.

Second, we asked whether adaptation to a new host causes cross-adaptation to other, never-encountered hosts, and thus leads to a general expansion of the insect's host range.

Third, we asked whether insect performance depends on whether parents developed in the ancestral host (mung bean) or the novel one (lentil).



Methods

To examine larval survival, we placed pairs of newly emerged adults from replicate lines into 40 petri dishes containing 75-100 seeds. Females laid eggs for 24 h and were then removed. After 10-15 days, seeds with one larva were collected. Each seed was isolated in a 4-ml vial and checked daily for emergence. For host acceptance, newly emerged beetle pairs were placed into 40 petri dishes containing 75-100 seeds per dish. After 15 days, the number of eggs laid per dish was scored.

Results

Beetle Line	% Survival		
	Mung	Lentil	Pea
M1	89.6	0.0	52.1
M2	88.5	2.1	43.8
L1	89.6	91.7	41.7
L2	83.3	88.5	33.3
L3	86.5	93.8	36.5
L1-M	89.6	91.7	55.2
L2-M	84.4	90.6	41.7
L3-M	82.3	92.7	41.7

Table 1. Survival to adult emergence in mung, lentil, and pea. Control lines M1 and M2 remained on the ancestral host, mung bean. L1-L3 lines had evolved on lentil for >170 generations. L1-M – L3-M lines were reverted to mung for one generation to test for an effect of parental host. Larval survival on mung bean only slightly decreased in the lentil lines, indicating **little or no tradeoff**. Survival on pea was not greater in the lentil lines than in the mung lines, suggesting **no cross-adaptation**. Survival on pea was somewhat **higher** if parents developed on mung instead of lentil.

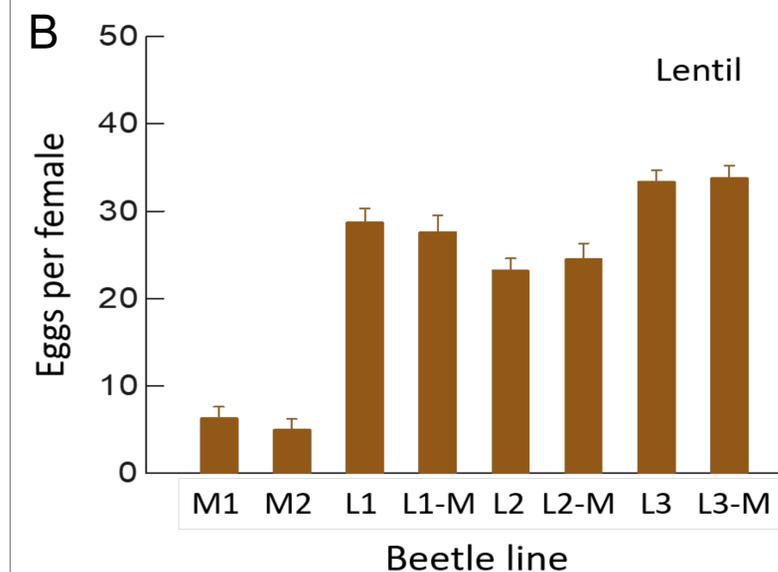
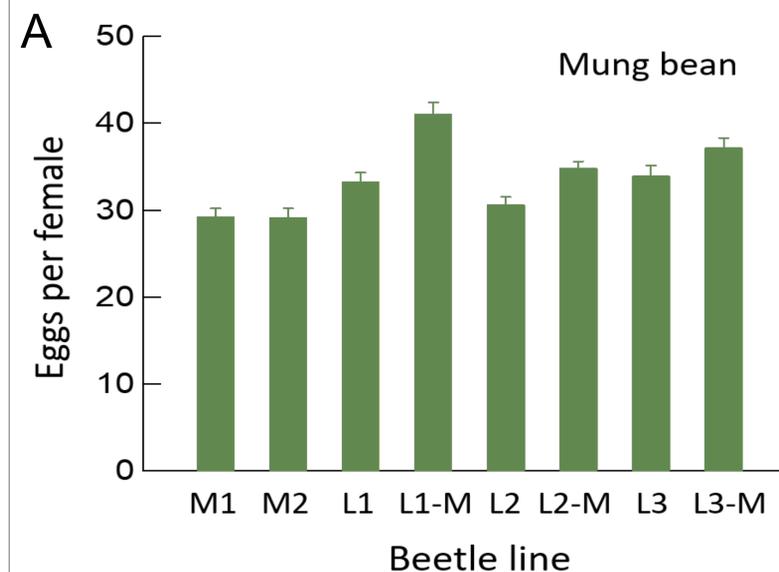


Figure 1A-B. Mean number (+SE) of eggs laid on mung (A) or lentil (B) by *C. maculatus* females from ancestral mung bean lines (M1-2), three lentil-adapted lines (L1-3) or three lentil-adapted lines that have been reverted to mung for a generation (L1-3M). Lentil-line females showed no reduction in the number of eggs laid on mung, indicating **no tradeoff**. Acceptance of lentil seeds was **4-6 times higher** in the lentil lines than in the mung lines. We are currently testing whether much greater egg-laying on lentil leads to greater acceptance of other novel, low-preference hosts (chickpea and glass beads).

Future Directions

To obtain evidence for cross adaptation with respect to host acceptance, we will measure egg laying on chickpea and glass balls. Measuring acceptance of glass balls, an artificial host without seed stimulants, will test whether a adaptation to lentil created a generally lowered threshold for oviposition.



Mung bean

Lentil



Chickpea

Glass beads

Fig. 2. Substrates used to compare host acceptance.

References

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Acknowledgements

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