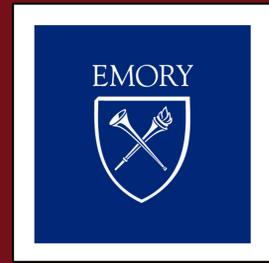




Why Do Bean Beetles Avoid Split Beans?

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Introduction

Our previously developed undergraduate laboratory studies (Blumer and Beck 2008, Beck and Blumer 2009, Beck, Migabo and Blumer 2011) have focused on the discrimination abilities of female bean beetles, *Callosobruchus maculatus*. Females have distinct preferences for specific bean species, beans without eggs, and large beans for egg laying substrates. Past research showed that not only do bean beetle prefer whole beans compared to split beans, but there is a greater rate of adult emergence from whole beans (Wasserman and Futuyma 1981). Offspring size and larval survival were equivalent on seeds that differed in moisture content, which in combination with the preference to lay eggs on the driest seeds would indicate that the egg laying decisions of *C. maculatus* females do not function to minimize larval water stress (Hudaib et al 2010). The aim of this experiment is to address the question: Are split beans more desiccated than whole beans and does this affect adult emergence rates? If split bean are typically more desiccated, we expect that raising humidity will eliminate differences in emergence rates from split and whole beans. Replicated cultures were prepared with whole and split beans and exposed to an increased humidity level. Emergence from each type of bean, whole and split, were measured and compared using beans with a single egg.

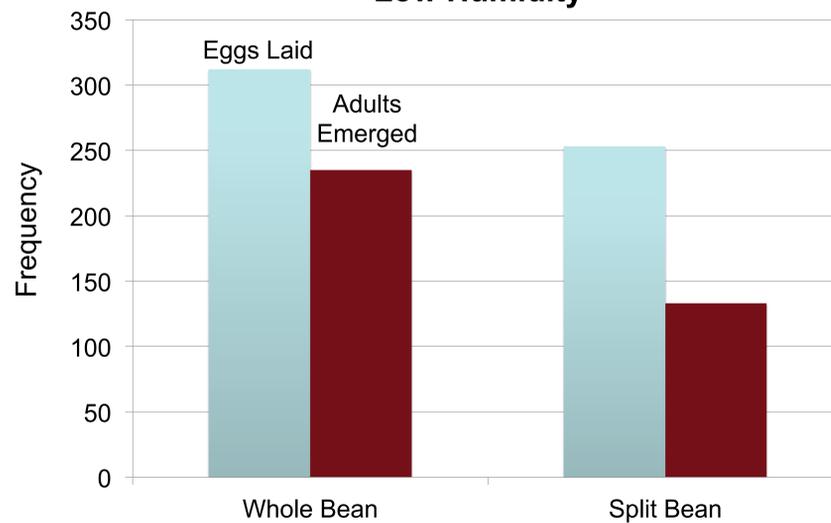
Methods

Nine female bean beetles, *C. maculatus*, were permitted to lay eggs on whole beans, and nine other females were permitted to lay eggs on split/half beans. Black-eye peas, *Vigna unguiculata*, were the substrate on which eggs were laid and in which larval and pupal development subsequently occurred. An entire incubator was used as a humidifier by placing a container of water under the bottom shelf. The relative humidity inside the incubator was measured by a hygro-thermograph. Average relative humidity during experiment was in the range of 90-95%. Single egg beans, both whole and split, were selected for the emergence study. Each single-egg-bean was placed in a well of 24-well plate and returned to the incubator at 30°C. Adult beetle emergence was typically occurs 3-4 weeks after egg laying at 30°C. We evaluated emergence 4-weeks after eggs were laid by looking for an adult emergence hole in each bean.

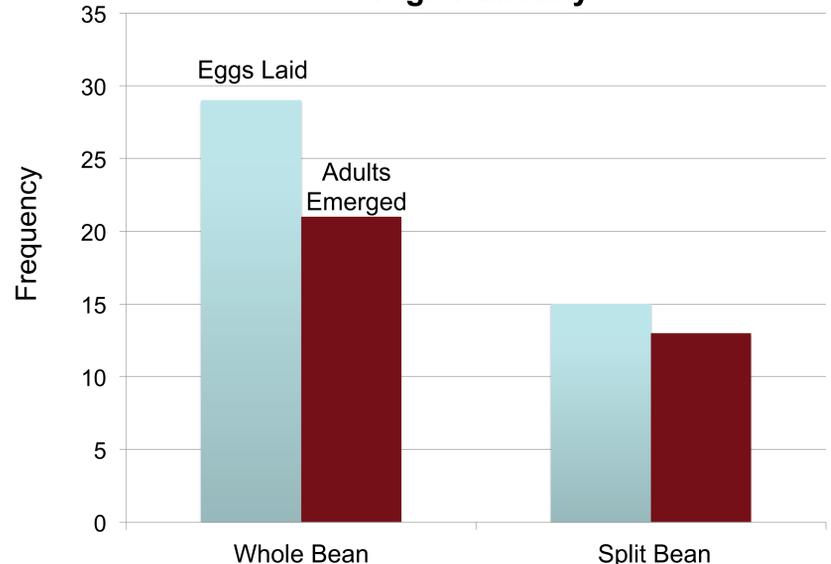
Results

A total of 29 whole beans with a single egg and 15 split beans with a single egg were evaluated at high relative humidity. There was no significant difference between the emergence rates from whole and split beans at high humidity ($\chi^2 = 0.14$, $p = 0.71$). An adult emerged from 21 of the 29 whole beans (72%), and from 13 of the 15 split beans (87%). Emergence rates from both whole and split beans at high relative humidity were compared to adult emergence from whole and split beans in earlier studies we conducted at lower ambient humidity. At lower ambient humidity (less than 70% RH), a total of 312 whole beans and 253 split beans each with a single egg were evaluated. The rate of emergence was significantly greater from whole beans than split beans at lower humidity ($\chi^2 = 6.85$, $p = 0.009$). Adults emerged from 235 of 312 whole beans (75%) but only 133 of 253 split beans (53%).

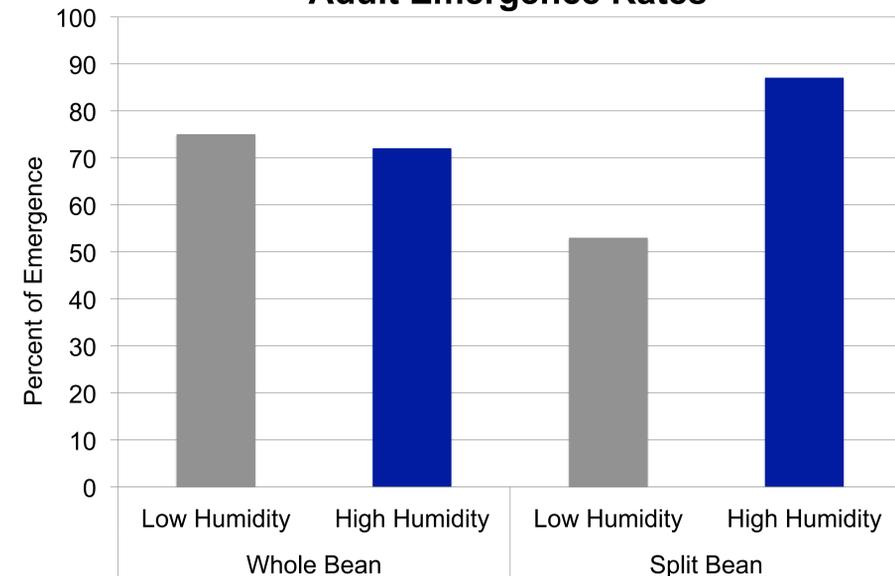
Low Humidity



High Humidity



Adult Emergence Rates



Conclusion

- Increased relative humidity resulted in an increased adult emergence rate in split beans eliminating the difference between whole and split beans.
- Desiccation under lower humidity conditions may be the cause for the lower success of larvae in split beans and female preference for whole beans.
- Our findings coincide with Schoof (1941) who reported significant negative effects of low relative humidity on bean beetle development from egg to adult emergence
- This experiment is very suitable for undergraduate level laboratories. Student handouts, notes for instructors, and sample data will be available at beanbeetle.org

Literature Cited

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