Title Effect of suboptimal temperatures and sublethal carbon dioxide levels on *Cryptolestes ferrugineus*, alone and in combination with *Tribolium castaneum*.

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Abstract

The adults of *C. ferrugineus* alone and in combination with adults of *T. castaneum*, were exposed to suboptimum temperatures (15, 20, and 25 deg C) and sublethal carbon dioxide (CO_2) levels (2, 5, and 10%) in dry (12% wb) and wet (15% wb) wheat to investigate their effects on adult survival. The mean adult survival of *C. ferrugineus* in single-species or mixed-species situations was positively correlated with temperature and moisture content and negatively correlated with CO_2 levels. Adult survival in single and mixed-species was lower at elevated but sublethal CO_2 levels compared with ambient CO_2 levels at all the test temperatures and decreased in dry grain compared with wet grain. Although a specific trend was not observed in population inhibition in mixed species compared with single-species, overall the adult population of *C. ferrugineus* was reduced in the presence of *T. castaneum*. The adult populations at experimental temperatures and CO_2 levels demonstrated that these are the stress factors reducing the population compared with the optimum conditions. A mathematical model was derived to predict adult populations of *C. ferrugineus* alone or in the presence of *T. castaneum* considering all the variables in this study. The model had an R2 value of 0.83 but this needs to be validated and refined with the field data.