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CAN INDIRECT HERBICIDE EXPOSURE MODIFY THE RESPONSE OF THE COLORADO POTATO BEETLE TO AN ORGANOPHOSPHATE INSECTICIDE

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Abstract

Organisms live in complex multivariate environments. In agroecosystems, this complexity is often human-induced as pest individuals can be exposed to many xenobiotics simultaneously. Predicting the effects of multiple stressors can be problematic, as two or more stressors can have interactive effects. Our objective was to investigate whether indirect glyphosate-based herbicide (GBH) exposure of the host plant has interactive effects in combination with an insecticide (azinphos-methyl) on an invasive pest Colorado potato beetle (*Leptinotarsa decemlineata* Say). We tested the effects of GBH and insecticide on the survival, insecticide target genes expression (acetylcholinesterase genes) and oxidative status biomarkers [glutathione S-transferase (GST), glucose-6-phosphate dehydrogenase (G6PDH), glutathione reductase homolog (GR), glutathione peroxidase homolog (GPx), total glutathione (totGSH), glutathione reduced-oxidized (GSH: GSSG), catalase (CAT), superoxide dismutase (SOD), lipid hydroperoxides]. We found that exposure to indirect GBH has no single or interactive effects in combination with the insecticide on larval survival. However, prior exposure to GBH inhibits Ldace1 gene expression by 0.55-fold, which is the target-site for the organophosphate and carbamate insecticides. This difference disappears when individuals are exposed to both GBH and insecticide, suggesting an antagonistic effect. On the other hand, oxidative status biomarker scores (PCAs of GPx, GR and CAT) were decreased when exposed to both stressors, indicating a synergistic effect. Overall, we found that indirect GBH exposure can have both antagonistic and synergistic effects in combination with an insecticide, which should be considered when aiming for an ecologically relevant risk assessment of multiple human-induced stressors.

Data description

Data files include survival (Margus etal survival.xls), oxidative biomarkers measurements (Margus etal oxidative stress measurements.xls), and gene expression data (Margus etal qPCR data.xls). The experiment was conducted in summer 2015.

Survival data represents the survival information (1=alive, 0=dead) after GBH (i.e. glyphosate-based herbicide) treatment (1=GBH, 0=control) and insecticide treatment (1=azinphos-methyl insecticide, 0=control). We have also included the parental genotypes (1=SS-SS, 2=SS-RS, 3=SS-RR, 4=RS-RS, 5=RS-RR, 6=RR-RR) and family to the data set.

Oxidative status biomarkers´ data represents the information about GBH treatment (1=GBH, 0=control), insecticide treatment (1=insecticide, 0=control) and measurements of various oxidative status biomarkers, GST (nmol/min/mg protein), G6PDH (nmol/min/mg protein), homolog GR (nmol/min/mg protein), homolog GPx (nmol/min/mg protein), tGSH (µmol/mg protein), GSH:GSSG (ratio), CAT (µmol/min/mg protein), SOD (inhibition %), and lipid hydroperoxides (nmol/mg body mass).

Gene expression data represents four treatment groups (control-control, control-insecticide, GBH-control, and GBH-insecticide), family, and mean Cq (i.e. quantification cycle) values for two target genes: *Ldace1*-, *Ldace2*-genes, and one reference *L13e*- gene. In addition this file also contains information about primer pair efficiencies (E% and R).

The more detailed information about the experimental setup can be found from the original publication.