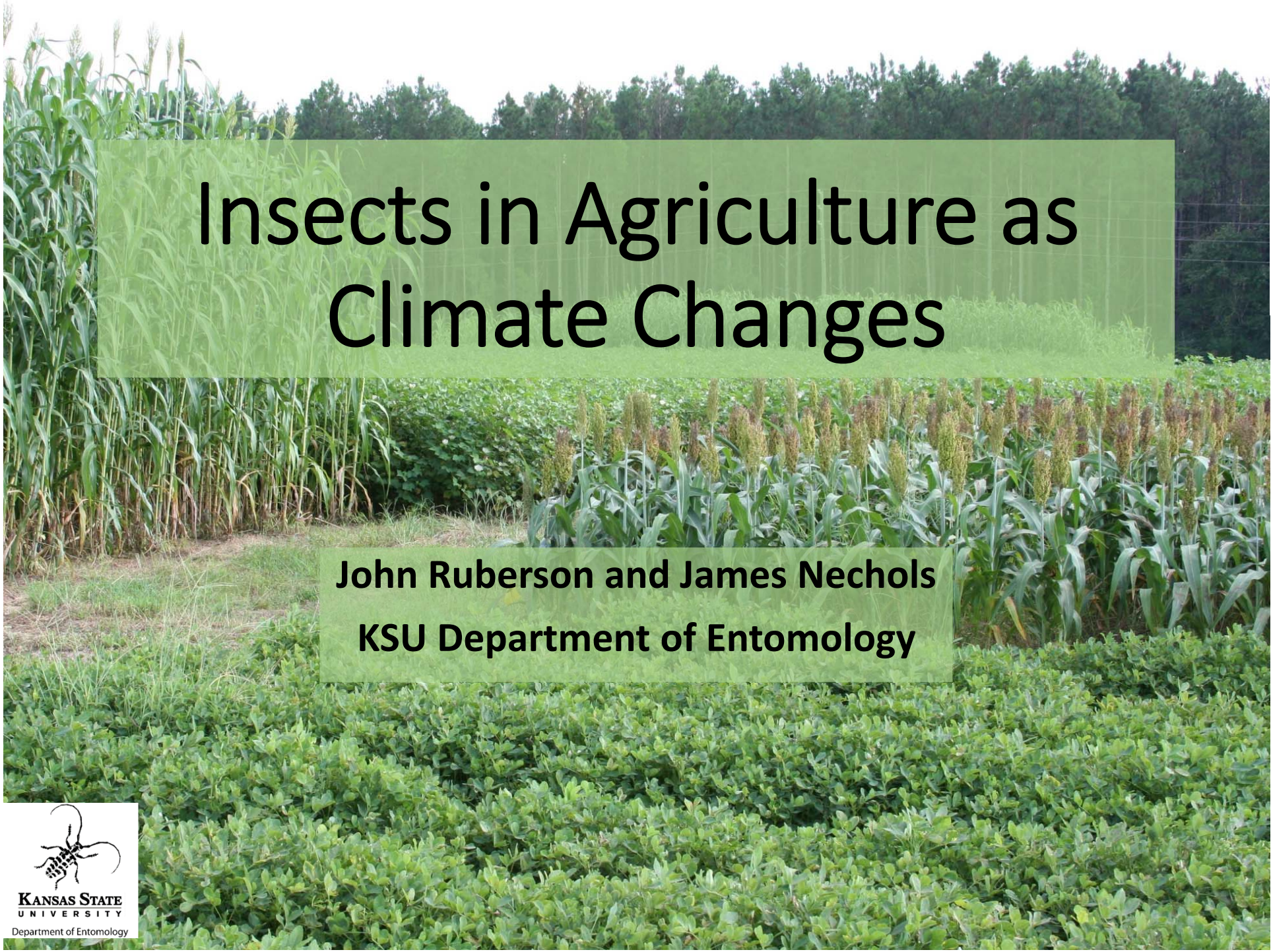


Insects in Agriculture as Climate Changes

John Ruberson and James Nechols

KSU Department of Entomology

Kansas State University
Department of Entomology

Overview

- Insects in Agriculture – What do they do?
- Some key concerns about changing climate and insects
- Selected effects of climate change
  - Microscale effects
  - Natural control of crop pests
- Knowledge gaps

Kansas State University
Department of Entomology

What roles do insects play –

- Pests: Direct, indirect, pathogen vectors
- Natural enemies of pests (insects and weeds)
- Pollinators: Importance highly variable
- Decomposers & Eco-engineers

Kansas State University
Department of Entomology

Expected Effects on Insects

Effects complex–

- May be beneficial
- May be detrimental
- May be neutral

Multiple levels of concern–

- Individual growth, behavior, reproduction, survival
- Population growth and distribution
- Community/trophic interactions

Kansas State University
Department of Entomology

Expected Effects on Insects

- Ectotherms - growth rates, feeding rates, reproductive rates
- Plant quality changes – temperature, rainfall, CO2, compensatory responses of plants and insects
- Ecosystem complexity: Novel communities (antagonism, complementarity, intraguild predation, etc.)

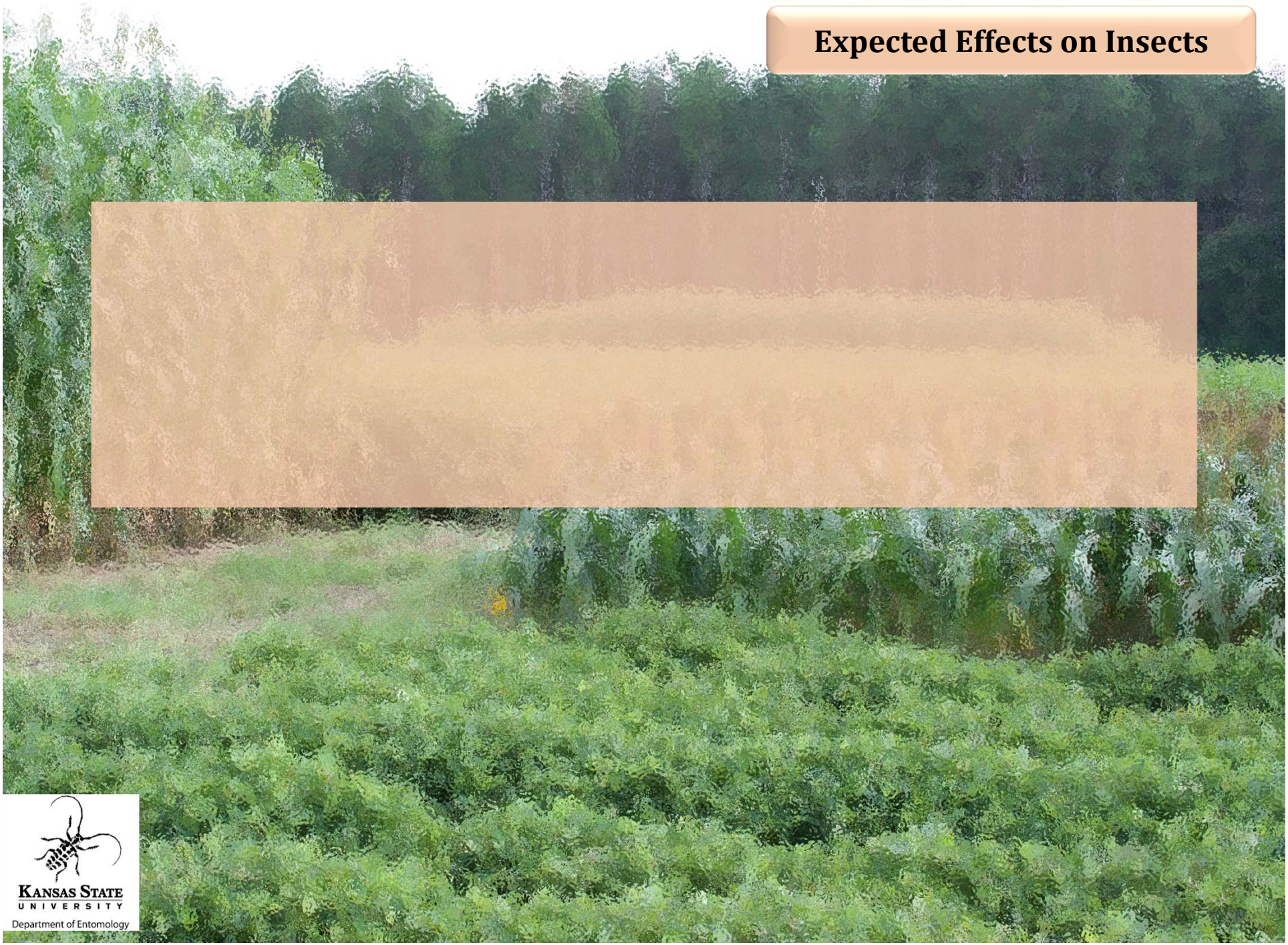
Kansas State University
Department of Entomology

Expected Effects on Insects

- Natural enemies – relationships/complexes, efficacy
- Pollination – Distribution of pollinators, foraging efficacy, population growth/diseases
- Symbionts – Insects and plants

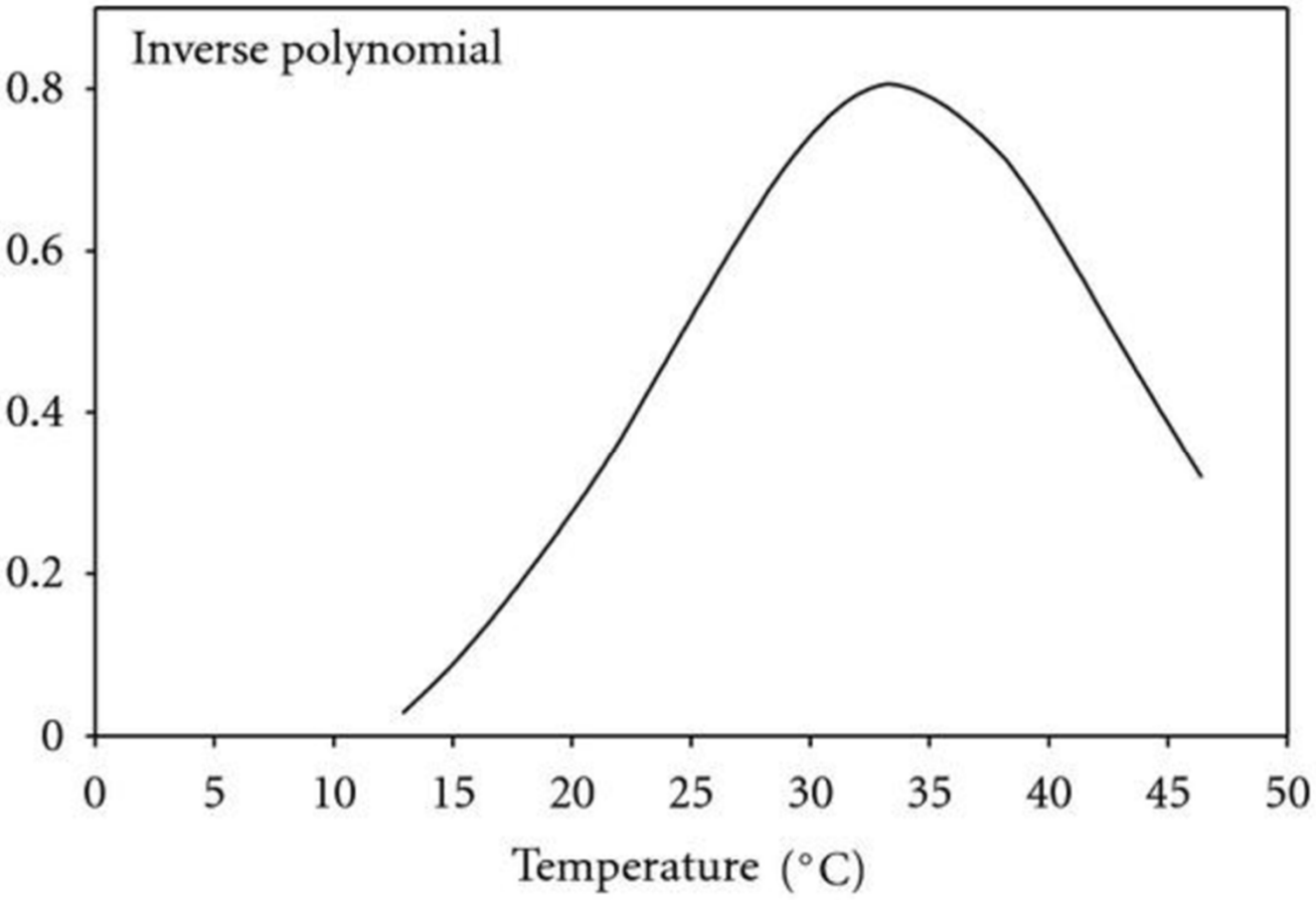
Kansas State University
Department of Entomology

Expected Effects on Insects

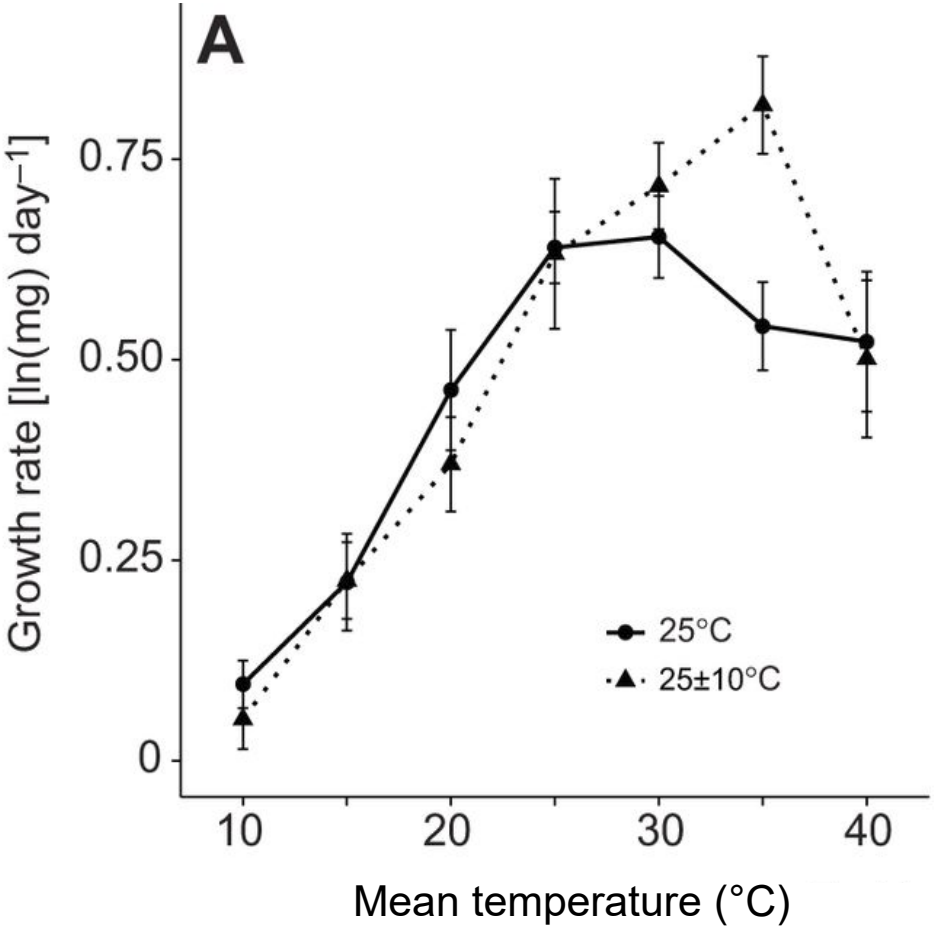


Kansas State University
Department of Entomology

Insect Development and Temperature



Insect Development and Temperature

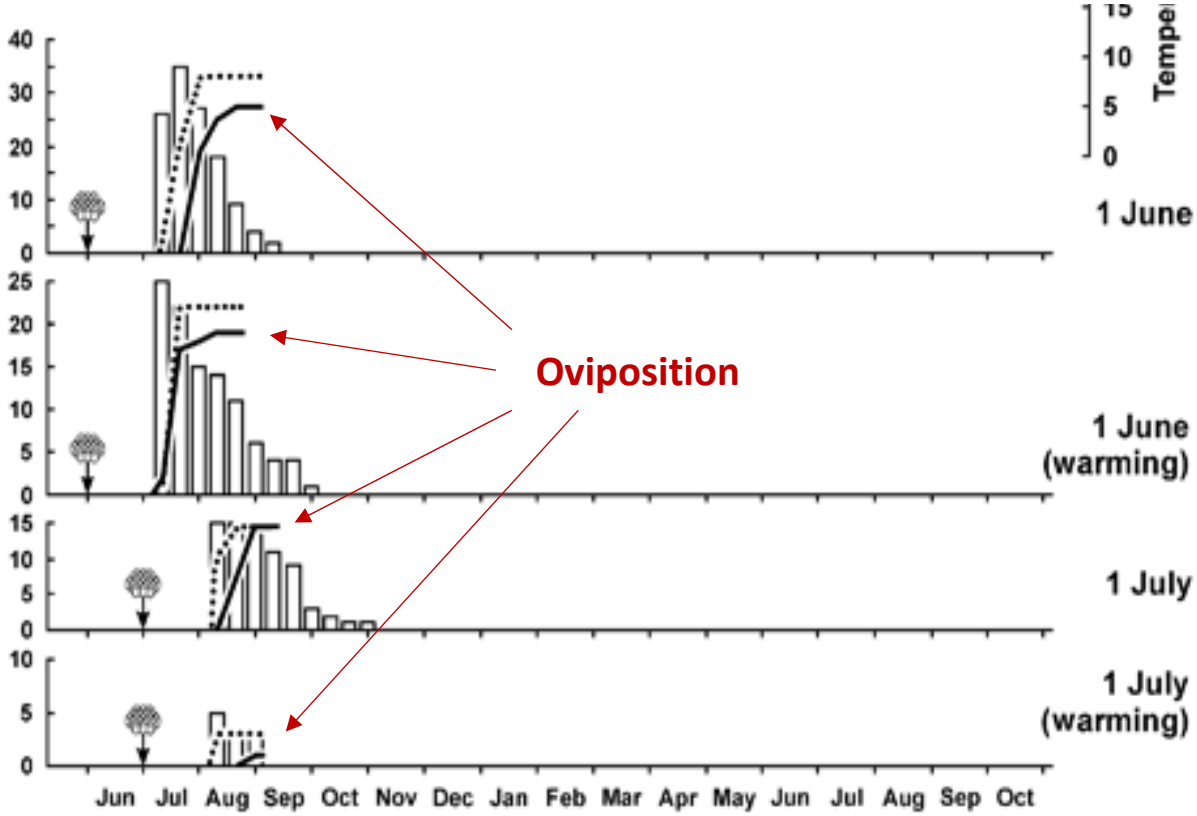


Tobacco hornworm

Kansas State University
Department of Entomology

Kingsolver et al. (2015) J Exp Biol 218:2218 – Fig. 1A

Microscale Effects on Insects



Southern green stink bug

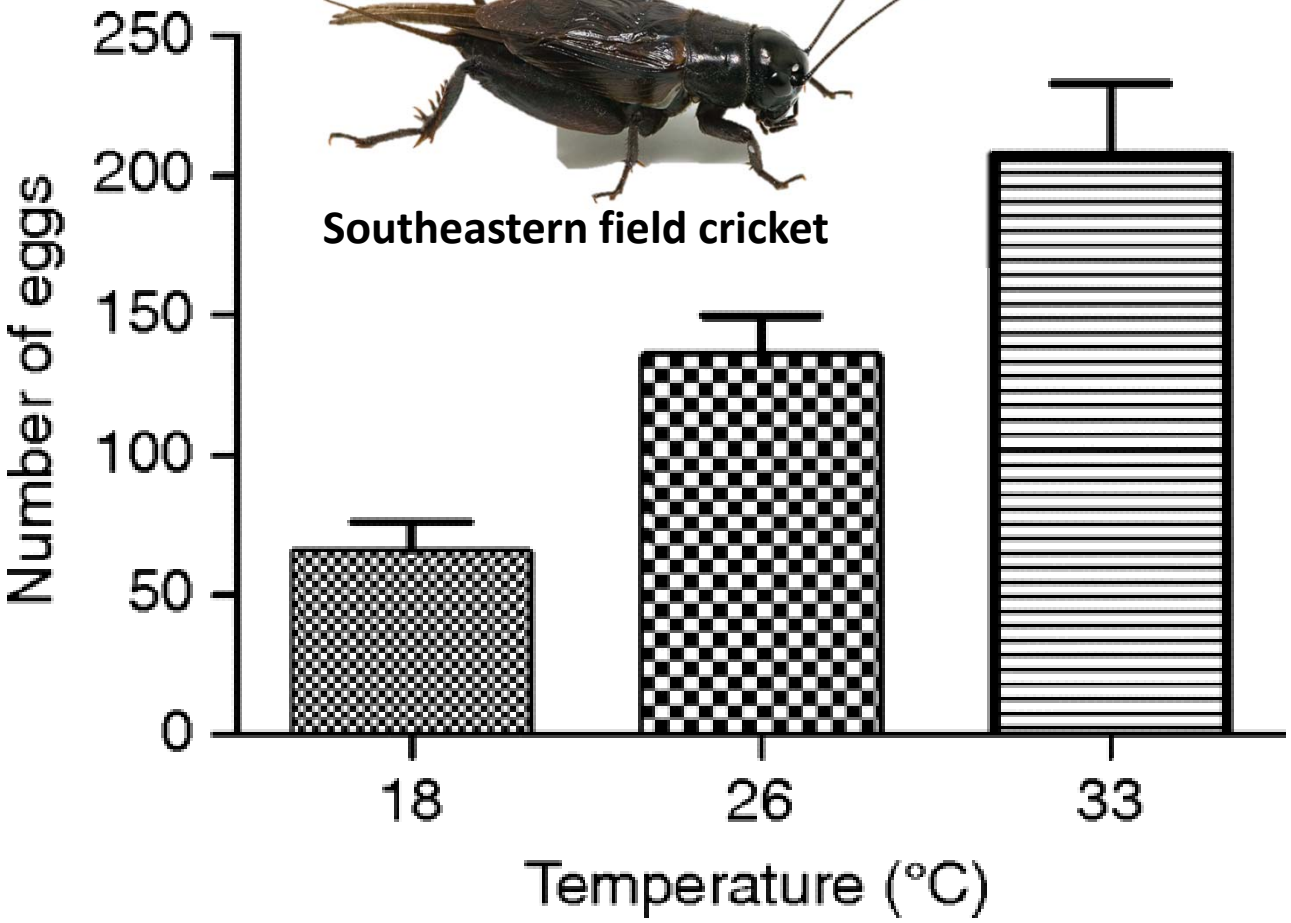
Kansas State University
Department of Entomology

Musolin et al. (2010) Global Change Biol 16:73 – Fig. 6

Insect Reproduction and Temperature

Microscale Effects on Insects

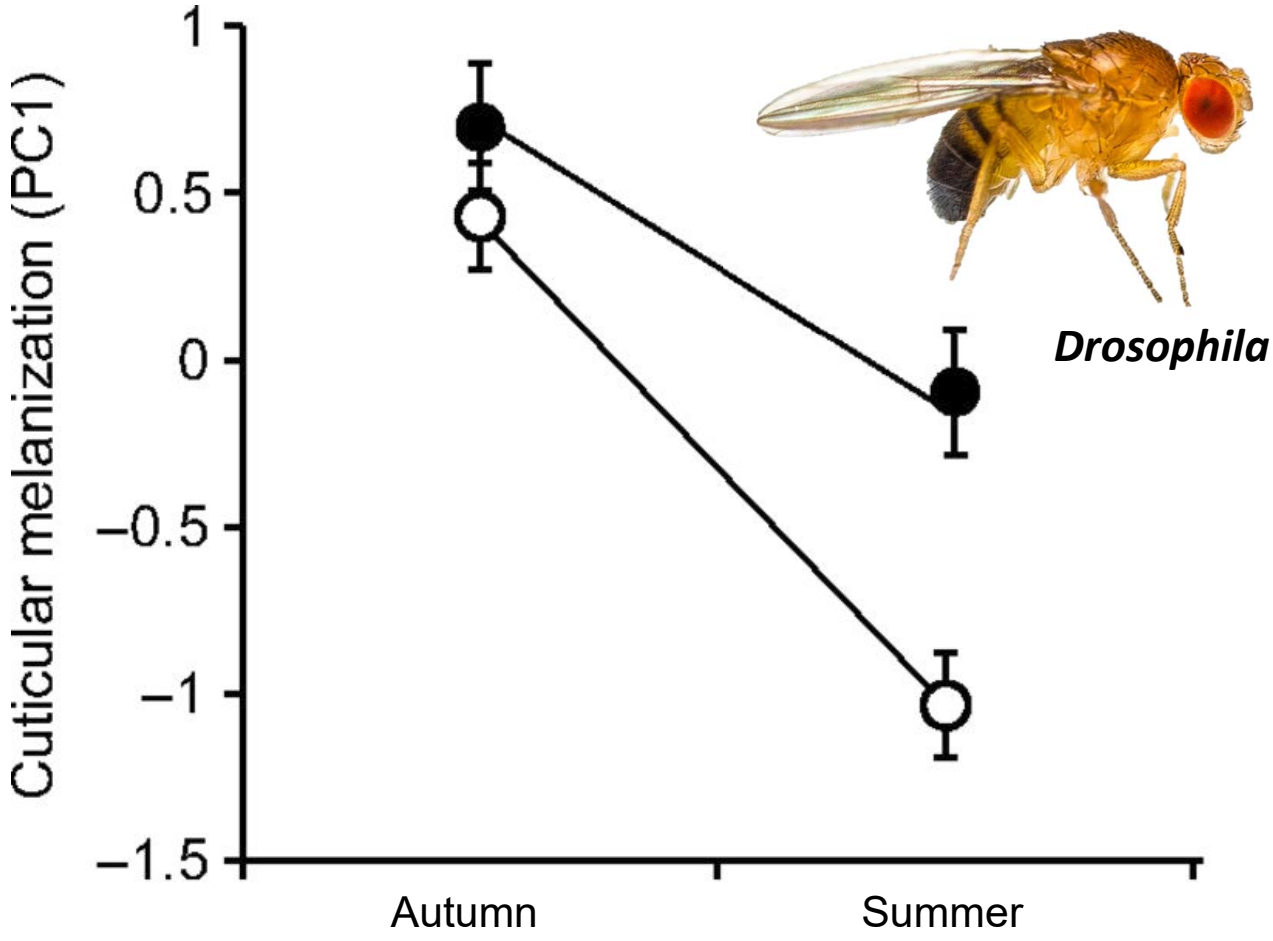
Southeastern field cricket



Adamo and Lovett (2011) J Exp Biol 214:1997 – Fig. 1

Kansas State University
Department of Entomology

Insect Immunity and Temperature

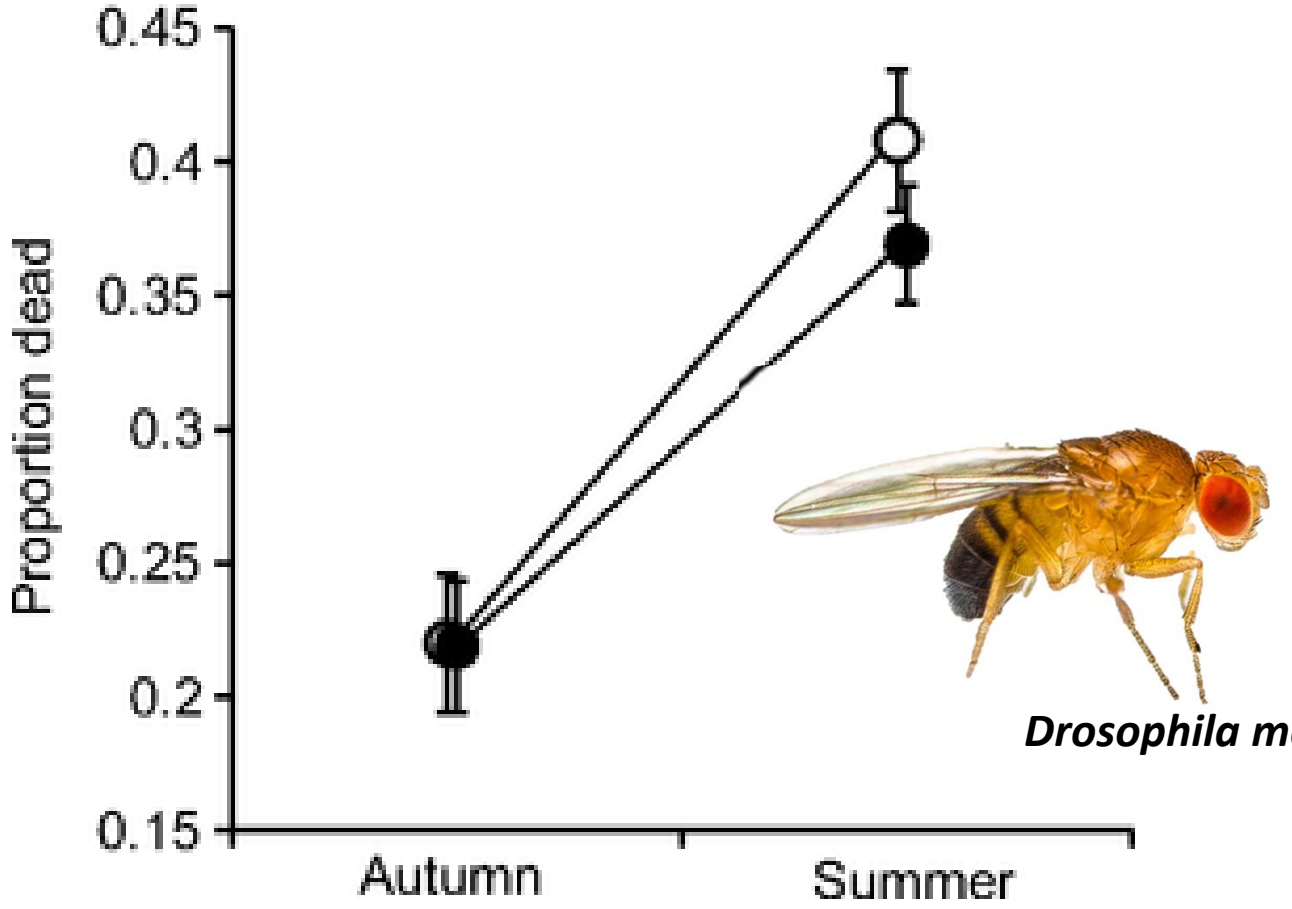


Drosophila melanogaster

Kansas State University
Department of Entomology

Kutch et al. (2014) J Exp Biol 217:3664 – Fig. 2

Insect Immunity and Temperature



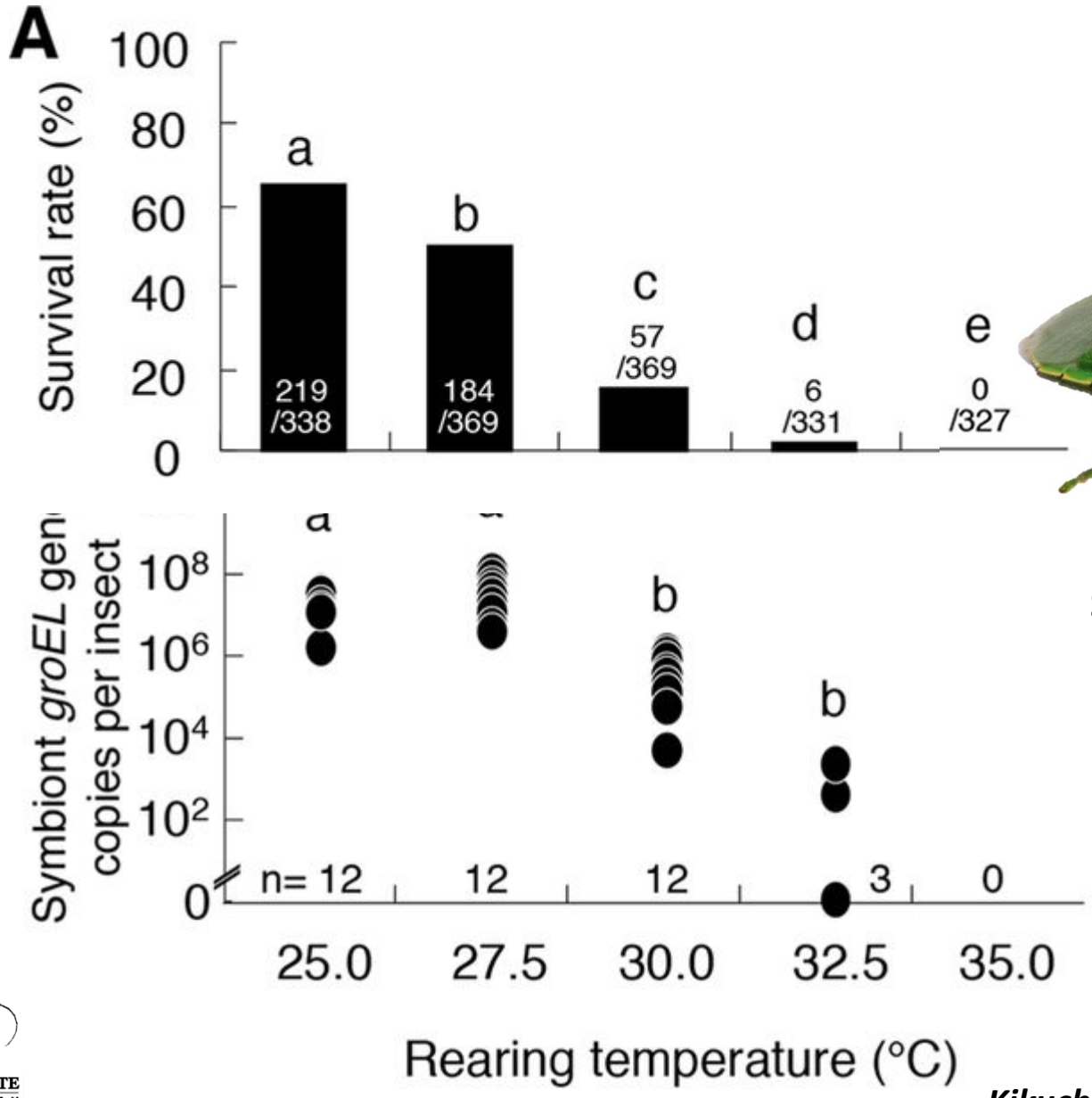
Drosophila melanogaster

Kansas State University
Department of Entomology

Kutch et al. (2014) J Exp Biol 217:3664 – Fig. 2

Insect Symbionts and Temperature

Microscale Effects on Insects

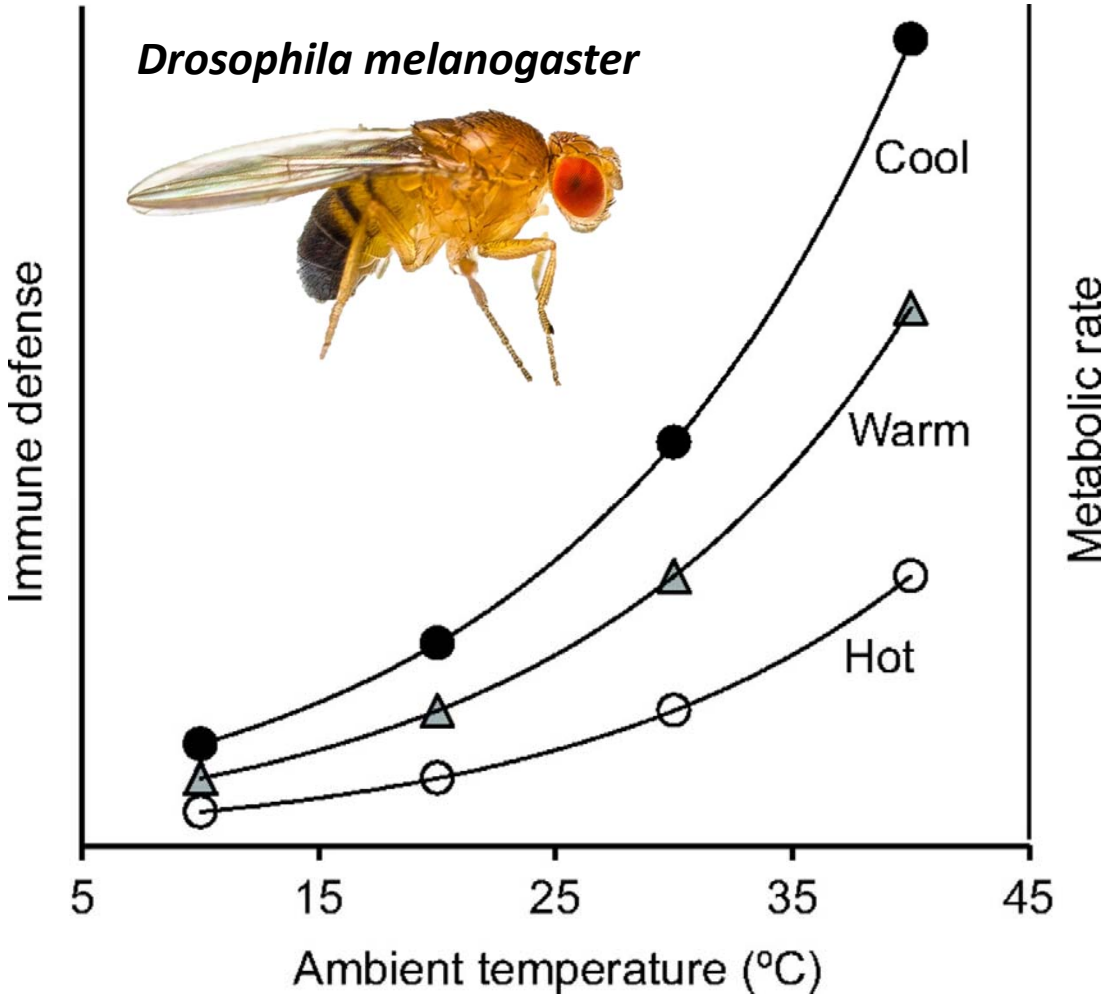


Southern green stink bug

Kansas State University
Department of Entomology

Kikuchi et al. (2016) mBio 7 – Fig. 3

Insect Immunity and Temperature



Kutch et al. (2014) J Exp Biol 217:3664 – Fig. 3

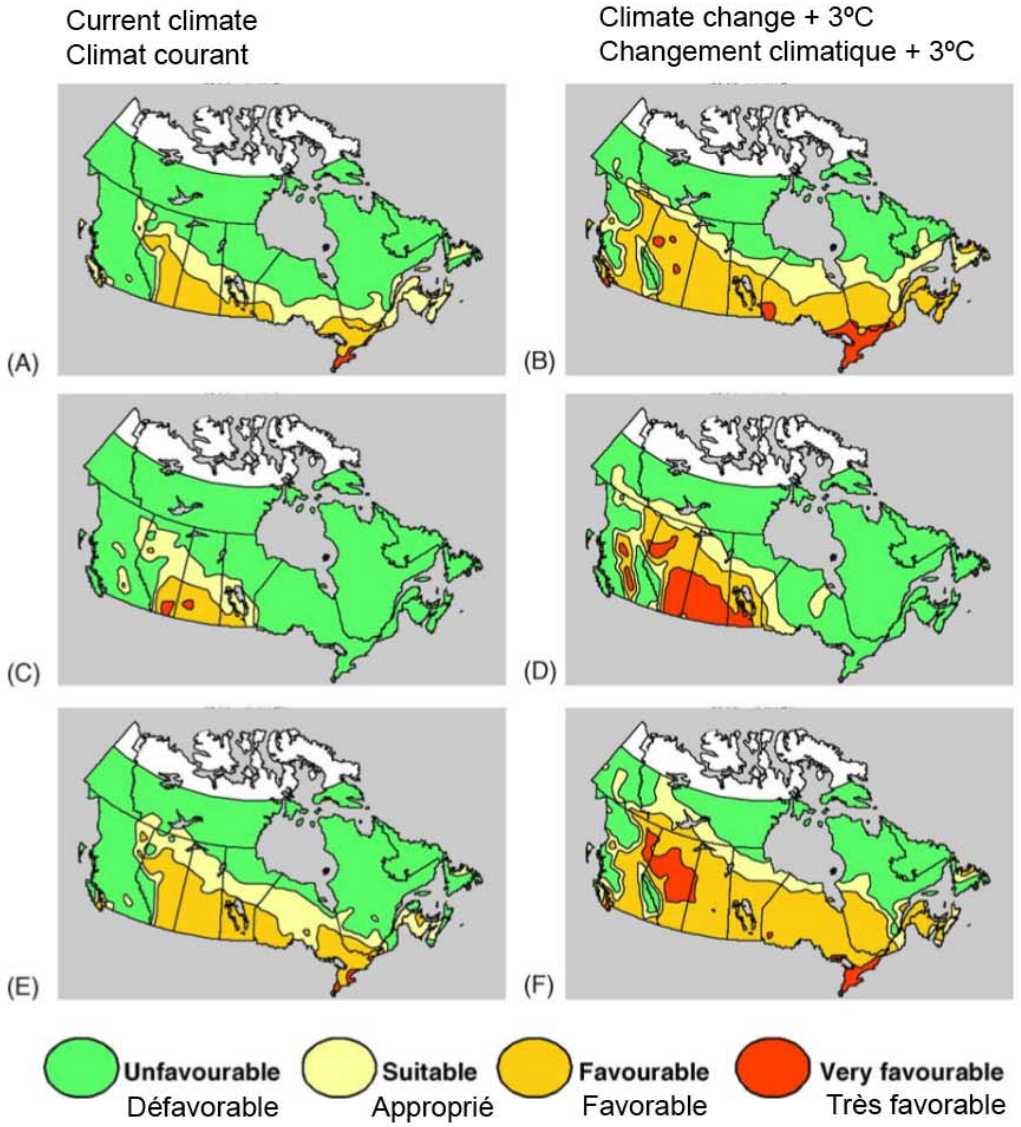
Pest Expansion into New Areas

Macroscale Effects on Insects

Cereal leaf beetle
Coléoptère de feuille de céréale
Oulema melanopus

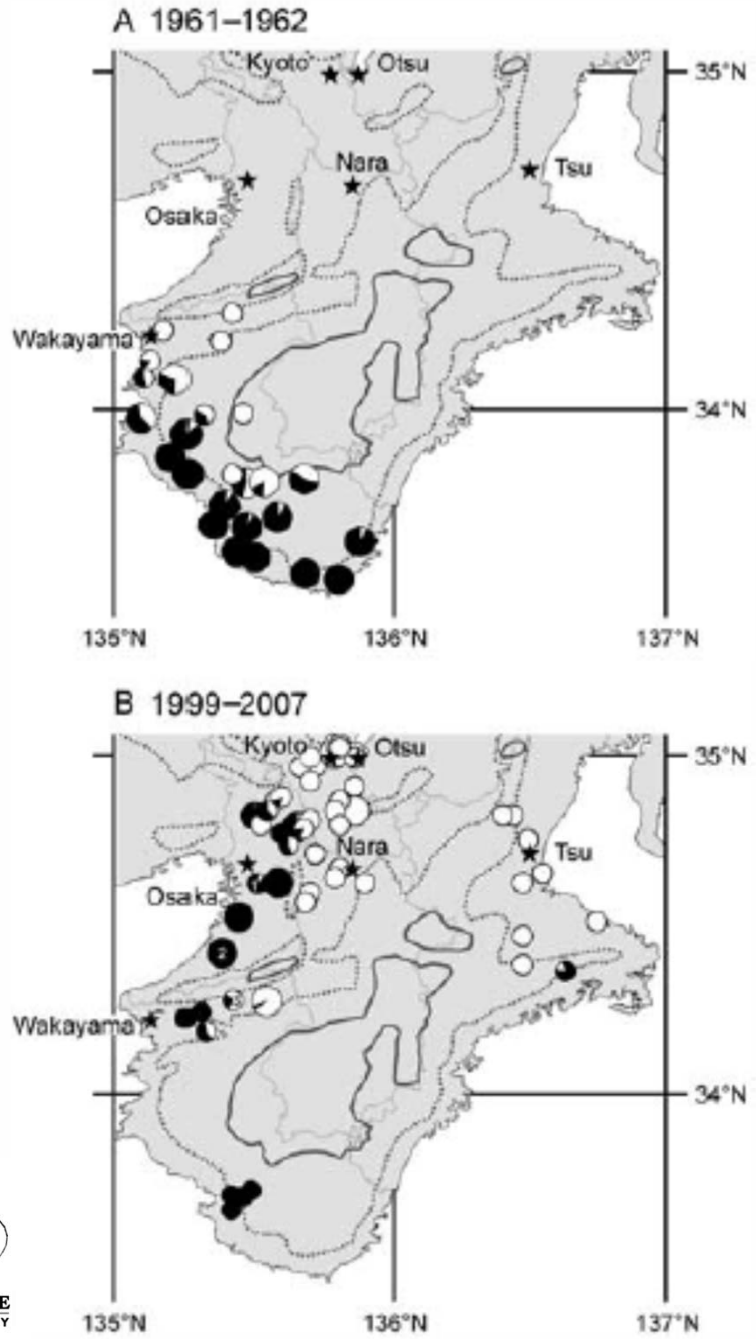
Cabbage seedpod weevil
Charançon de graine de chou
Ceutorhynchus obstrictus

Bronzed or rape blossom beetle
Coléoptère des fleurs du colza
Meligethes viridescens



Adapted from: Olfert, O., and Weiss, R.M. 2006. Impact of climate change on potential distributions and relative abundances of *Oulema melanopus, Meligethes viridescens,* and *Ceutorhynchus obstrictus* in Canada. Agriculture, Ecosystems and Environment 113: 295: 301.

Pest Expansion into New Areas

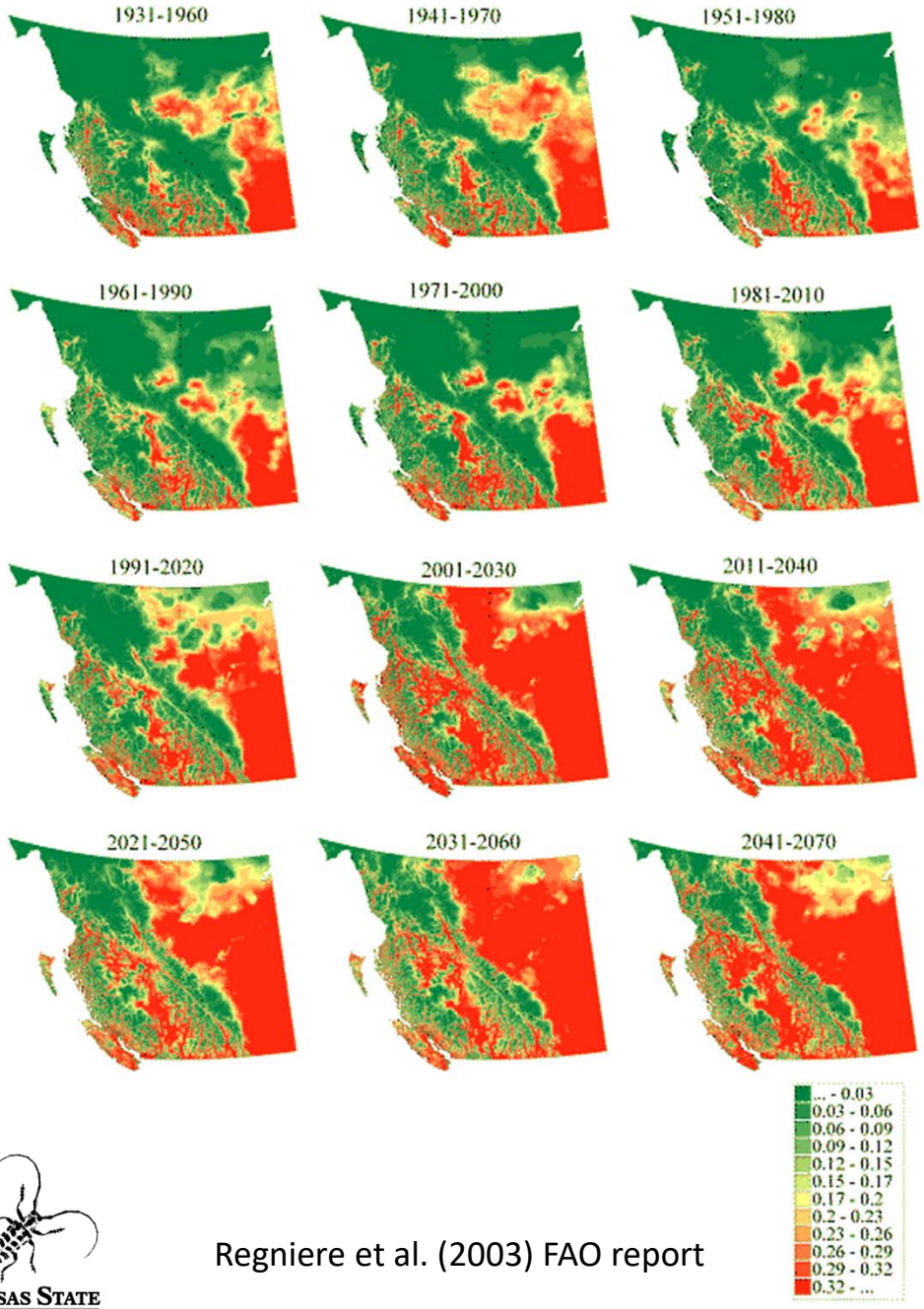


Southern green stink bug

Tougou et al. (2007) Ent Exp Appl 130:249 – Fig. 2

Kansas State University
Department of Entomology

Macroscale Effects on Insects



Regniere et al. (2003) FAO report

Improved winter survival – Greater pest severity

Mountain Pine Beetle in Alberta and British Columbia

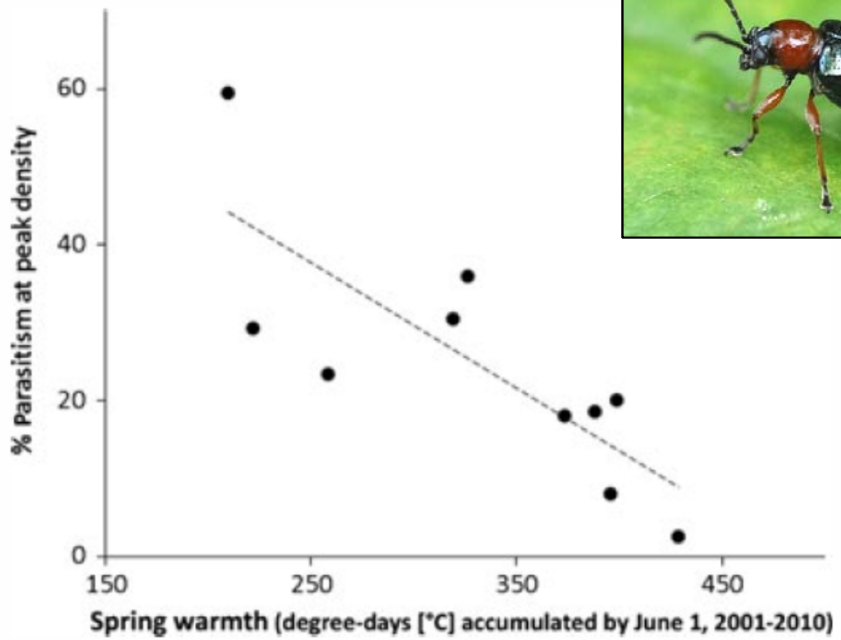
KANSAS STATE UNIVERSITY
Department of Entomology

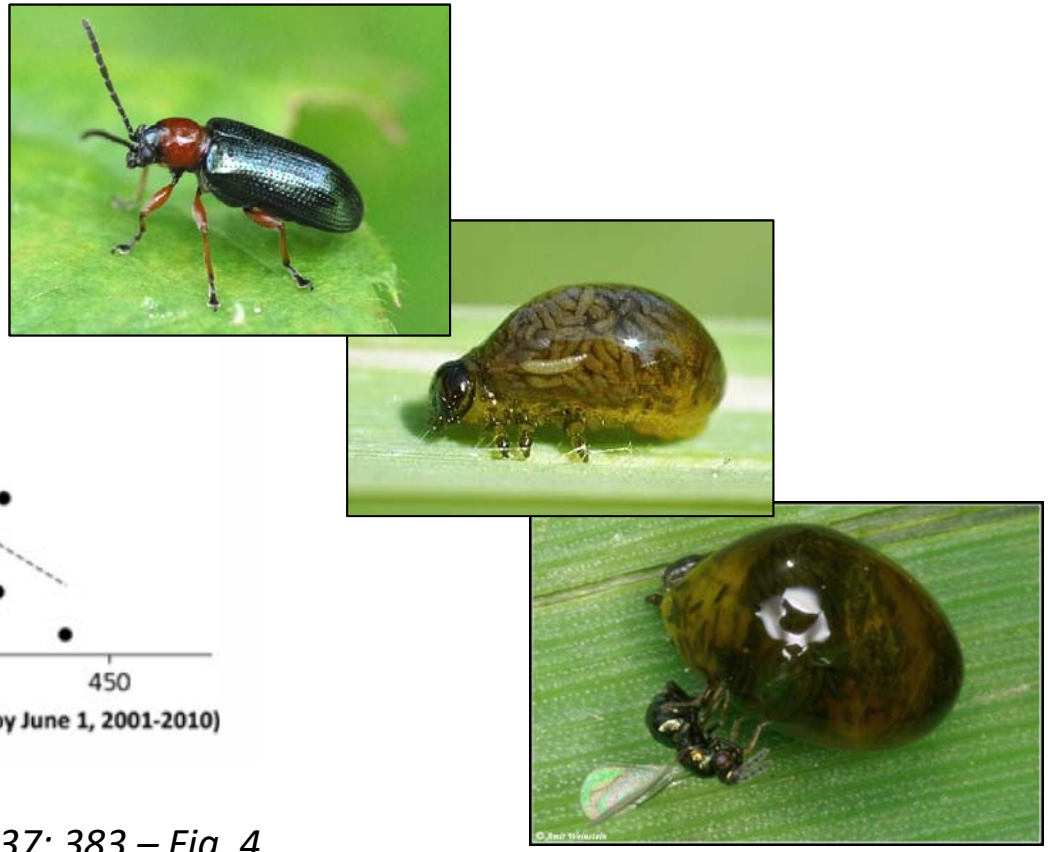
Natural Control

- Asynchrony
- Different thermal tolerances between species creating differential survival
- Foraging efficiency, success
- Changes in plant resources/quality

Kansas State University
Department of Entomology

Natural Control





Evans et al. (2013) J Appl Ent 137: 383 – Fig. 4

Knowledge Gaps

- Appearance/expansion of invasive pest species
- Changes in importance of native species
- Effects on biological control
- Pollination – Distribution of pollinators, foraging efficacy, population growth/diseases
- Symbionts – Microbial interactions still poorly known
- Limited historical datasets

Kansas State University
Department of Entomology

KANSAS STATE UNIVERSITY
Department of Entomology