

Supplementary Information - Supporting Data

Title: An energetics-based honeybee nectar-foraging model used to assess the potential for landscape-level pesticide exposure dilution

Johannes M. Baveco, Alterra, Wageningen University & Research Center, Wageningen, The Netherlands

Andreas Focks, Alterra, Wageningen University & Research Center, Wageningen, The Netherlands

Dick Belgers, Alterra, Wageningen University & Research Center, Wageningen, The Netherlands

Jozef J.M. van der Steen, Plant Research International, Wageningen University & Research Center, Wageningen, The Netherlands

Jos J.T.I. Boesten, Alterra, Wageningen University & Research Center, Wageningen, The Netherlands

Ivo Roessink, Alterra, Wageningen University & Research Center, Wageningen, The Netherlands

Estimates of attack-rate for clover and oilseed rape

Clover

Data from (Goodwin et al. 2011)

MathCad code:

$$\text{flDensity} := 2808 \quad \text{flPerSec} := \frac{3.79}{11.33} \quad \text{h} := 1.215 \quad \text{handling time per floret (s)}$$

$$\text{GF}(\alpha) := (\text{flPerSec}) - \left(\alpha \cdot \frac{\text{flDensity}}{1 + \alpha \cdot \text{flDensity} \cdot \text{h}} \right)$$

$$\alpha := 0.0001$$

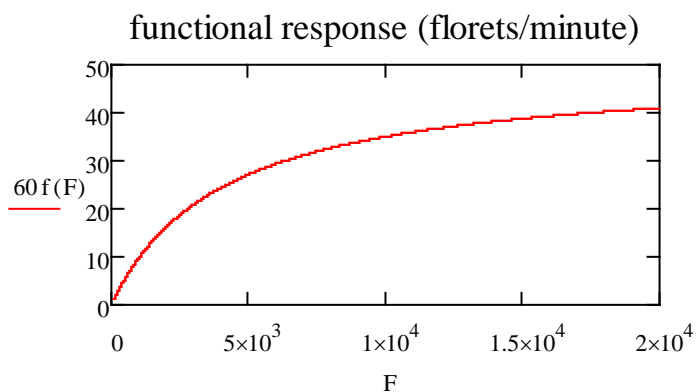
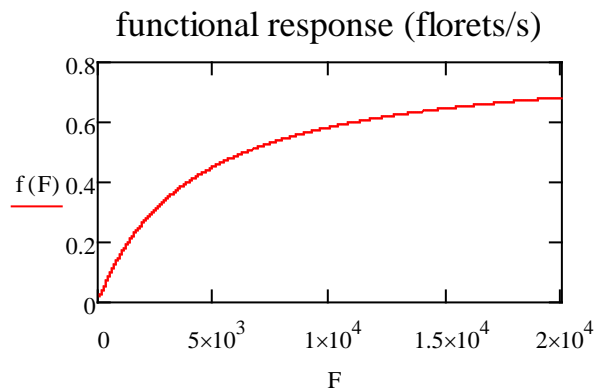
$$\text{acalc} := \text{root}(\text{GF}(\alpha), \alpha)$$

$$\text{acalc} = 2.007 \times 10^{-4}$$

$$f(F) := \text{acalc} \cdot \frac{F}{(1 + \text{acalc} \cdot F \cdot \text{h})} \quad \text{functional response (florets per second)}$$

$$F := 100..20000$$

$$\frac{1}{\text{h}} = 0.823 \quad \text{asymptotic value functional response}$$



$$f(2808) = 0.335$$

Oil-seed rape

Own experiment 2015 (September)

Open flower density: 264 m⁻²

Measured f (flowers per minute): 9 (+/- 2, n=3); 15 (+/- 2, n=5); average: 12.

Handling time per flower h (s): 4.1 (Free & Nuttall 1968)

MathCad code:

$$\text{flPerSec} := \frac{12}{60} \quad \text{flDensity} := 264 \quad h := 4.1 \quad \text{handling time per flower (s)}$$

$$\text{GF}(\alpha) := (\text{flPerSec}) - \left(\alpha \cdot \frac{\text{flDensity}}{1 + \alpha \cdot \text{flDensity} \cdot h} \right)$$

$$\alpha := 0.0001$$

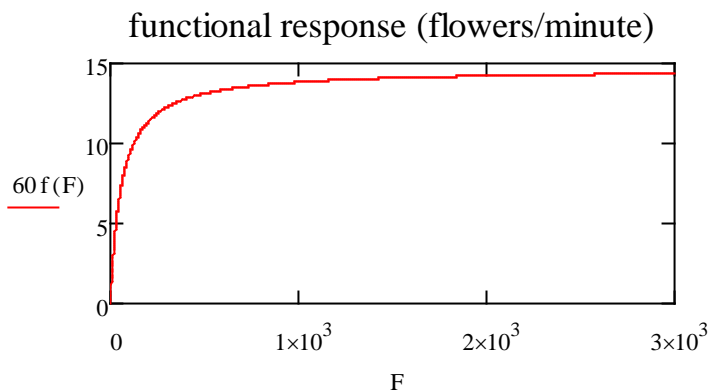
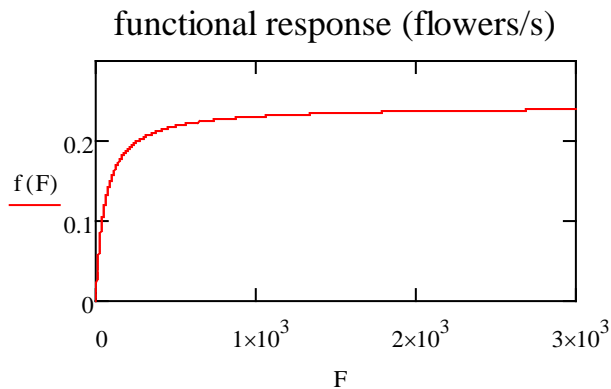
$$\text{acalc} := \text{root}(\text{GF}(\alpha), \alpha)$$

$$\text{acalc} = 4.209 \times 10^{-3}$$

$$f(F) := \text{acalc} \cdot \frac{F}{(1 + \text{acalc} \cdot F \cdot h)} \quad \text{functional response (flowers per second)}$$

$$F := 0..3000$$

$$\frac{1}{h} = 0.244 \quad \text{asymptotic value functional response}$$



$$f(\text{flDensity}) = 0.2$$

References

- Free JB, and Nuttall PM. 1968. The pollination of oilseed rape (*Brassica napus*) and the behaviour of bees on the crop. *The Journal of Agricultural Science* 71:91-94.
- Goodwin RM, Cox HM, Taylor MA, Evans LJ, and McBrydie HM. 2011. Number of honey bee visits required to fully pollinate white clover (*Trifolium repens*) seed crops in Canterbury, New Zealand. *New Zealand Journal of Crop and Horticultural Science* 39:7-19.