



Fig. 7. GIS maps below 1000 m of: (A) maximum vegetative dry matter (g per m²), (B) maximum capitula per m², (C) seed pool per m² at the beginning of the growing period, and (D) seeds per m² on the final year of an 8-year simulation (September 1995–September 2003) using weather from 72 locations. The color red indicates higher densities, green lower densities. The + symbol in the maps are the locations of weather stations.

E. villosus and *C. succinea* reduced seed production on average 58% across the entire region with *C. succinea* having the greatest impact. The impact of *C. succinea* is reduced by its interactions with *E. villosus* because the weevil larva kills fly larvae when they co-occur in capitula. The *EvCs* interaction increased seed survival 12.8% offsetting much of *Ev*'s contribution.

Mature flowering plant densities declined with abiotic factors that increased season length (dd, mm) as well as *E. villosus*, *C. succinea*, and competition from annual grasses.

$$\begin{aligned} \text{mature plant density} = & 219.4 - 0.012 \text{ dd} - 0.01 \text{ mm} \\ & - 12.0Ev - 30.0Cs \\ & + 8.6EvCs - 7.9G, \end{aligned} \quad (21)$$

$$R = 0.22, \quad F = 27.6, \quad df = 3233.$$

Again, the *EvCs* interaction decreased biological control (i.e., increased plant density). Using average dd and mm,

average mature plant density was estimated to be 142 per m² across the entire region.

The number of capitula per m² increased with season length (dd), cumulative rainfall (mm), and *C. succinea* presence, but was greatly reduced by *E. villosus* presence with the contribution of the *EvCs* interaction playing a minor role.

$$\begin{aligned} \text{capitula density} = & 171.8 + 0.052 \text{ dd} + 0.16 \text{ mm} \\ & - 105.3Ev + 22.3Cs - 29.8EvCs, \end{aligned} \quad (22)$$

$$R = 0.53, \quad F = 248.6, \quad df = 3234.$$

Again, using average values for dd and mm, average capitula density across the entire region was estimated to be 271 per m².

3.3.2. Cumulative overwintering insect stages

The number of overwintering insects in the final year of simulation was used as a metric of activity after the