Effects of herbicide drift on hedgerow biodiversity

Beate Strandberg (bst@dmu.dk)
K.K. Christensen

National Environmental Research Institute
University of Aarhus, Dept. of Terrestrial Ecology

Aims

To study the effects of the herbicide Starane 180S on flowering and pollen production of two perennial species when applied to one year old plants before flowering was initiated.

To asses flowering of hedgerow bottom vegetation in hedgerows at organic and conventional farms.

Background

Hedgerows play an important role in the fragmented agricultural landscape as corridors between natural habitats. In addition, hedgerow vegetation acts as a necessary structural support for many insects and supplies food for insects and birds. Thus, hedgerows may contribute significantly to biodiversity in the agricultural landscape.

Omitting herbicides as in organic farming significantly increases hedgerow biodiversity (Aude et al. 2003, 2004). We wanted to see if an increase in diversity resulted in more flowering species and thereby in greater availability of pollen, nectar and seeds. We selected dandelion (*Taraxacum* sp.) and red clover (*Trifolium pratense*) for the experiments, because they are much more frequent in hedgerows at organic farms (Aude et al. 2003), and they are important pollen and nectar producers.

Conclusions

Low dosages of herbicides may reduce the number of flowers on non-target plants. Effect of herbicides on flowering and on pollen and nectar production are relevant end-points for effect assessment on non-target species.

Herbicides have the potential to reduce the number of flowers in hedgerow vegetation and thereby also decrease the availability of pollen, nectar and seeds that are important food for many insects and birds.

The biodiversity of hedgerow bottom vegetation is lower at conventional than at organic farms, presumably as a consequence of the herbicide use.

A Effects of Starane 180S on flowering & pollen production

Materials and methods

One year old plants of dandelion (*Taraxacum* sp.) and red clover (*Trifolium pratense*) grown in pots under field conditions were exposed to Starane 180S (fluroxypyr) in a spraying chamber when the flower buds were ready to open (Figure 1). The herbicide was applied at four dosages (0–0.8 L/ha). Label rate of Starane 180S in winter cereals is 0.8 L/ha with 0.96 g fluroxypyr/L. Fluroxypyr has an auxin effect.

Numbers of flowers per plant, pollen production per flower and pollen viability were estimated ten times in the six weeks following herbicide application. Pollen viability was tested by aceto-carmin staining.

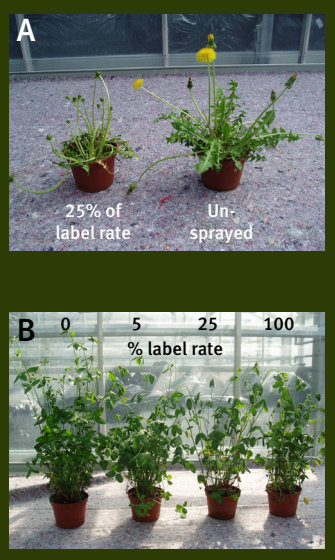

Figure 1. (A) Dandelion (*Taraxacum* sp.) and (B) Red clover (*Trifolium pratense*) 5 days after exposure to Starane 180S (fluroxypyr).

Results

The number of flowers per plant of red clover (Figure 2) was significantly and negatively affected by Starane 180S, whereas flowering of dandelion was slightly stimulated at low dosages. When the two species were exposed to full label rate the flower buds present at the time of herbicide application never opened. Starane 180S also delayed flowering in red clover and thereby shortened the flowering period.

Starane 180S had no direct effect on the number of pollen and pollen viability when applied to plants immediately before flowering, but affected the number of pollen per plant through the effect on numbers of flowers per plant.

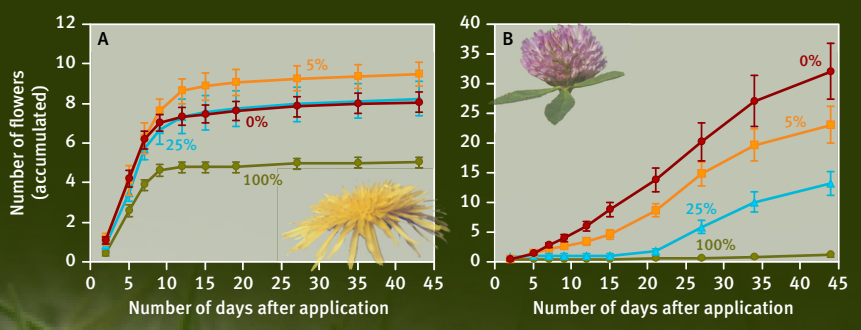

Figure 2. Numbers of flowers per plant (± S.E) on one year old plants of dandelion (*Taraxacum* sp.) and red clover (*Trifolium pratense*) exposed to four dosages of Starane 180S (fluroxypyr) accumulated in the six week period after herbicide application. Label rate is 0.8 L Starane/ha with 0.96 g fluroxypyr/L).

B Assessment of flowering of hedgerow bottom vegetation

Materials and methods

Within 30 north-south running, old (>50 y) deciduous hedgerows (20 at organic farms, 10 at conventional farms) a 100 m transect on the west facing side was selected for the assessment. At the organic farms time since transition to organic farming varied from 3 to 30 years. Flowering was assessed once each month in the period early May to late September by counting all flowering species, measuring flowering frequency as the fraction of 1 m^2 subplots in which the species was found to be flowering and counting the number of flowers per plant.

Results

The number of flowering species in the hedgerow bottom vegetation was significantly higher in hedgerows at organic farms (Figure 3), presumably because of the absence of pesticides, as soil nitrogen availability did not differ. Time since transition to organic management also plays an important role for hedgerow biodiversity.

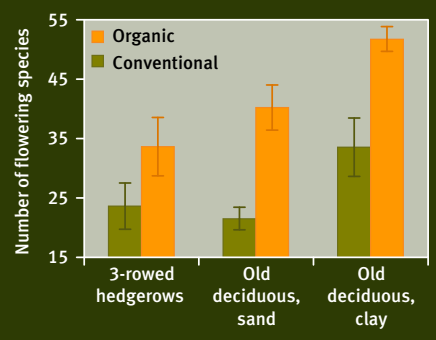

Figure 3. Number of flowering species at 100 m west facing transects in hedgerow bottom vegetation in hedgerows at organic and conventional farms. Data species diversity within the 15 years old hedgerows is from Aude et al. (2004).

Dandelion was found within both conventional and organic hedges, but its flowering frequency was considerably lower at conventional farms that at organic farms (0.2 ± 0.1 and 2.7 ± 0.6, respectively).

Most species showed the same pattern as dandelion, but wild chervil (*Antricus sylvestris*) made an exception, with flowering frequencies of 2 ± 0.6 and 0.9 ± 0.4 in hedgerows at conventional and organic farms, respectively. Red clover was one of the species only found in hedgerows at organic farms.

The mean number of flowers per plant was 1.0 ± 1.2 and 5.5 ± 0.9 for dandelion (*Taraxacum* sp.) within hedgerows at conventional and organic farms, respectively.

References

Aude, E., Tybirk, K. & Bruus Pedersen, M. 2003. Vegetation diversity of conventional and organic hedgerows in Denmark. – Agriculture, Ecosystems & Environment 99, 135–147.

Aude, E., Tybirk, K., Michelsen, A., Ejrnæs, R., Hald, A.B. & Mark, S. 2004. Conservation value of the herbaceous vegetation in hedgerows – does organic farming make a difference? – Biological Conservation 118, 467–478.