Management of fallows to enhance flowers availability for honeybees

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One main consequence of intensive agriculture is a move from heterogeneous habitats to more homogeneous habitats [1]. To temporally and spatially increase heterogeneous habitats for bees, it is urgent to preserve current semi-natural habitats (hedgerows, field margins, boundary vegetation) in farmlands. In addition, regulations advocating the management of **uncropped farmlands for increased floral availability to bees** could contribute to the maintenance of beekeeping activities in farmlands (at risk today, especially in intensive cereal farming areas) [2]. **But the benefits of these agri-environmental measures are still poorly known in the honeybee: how to optimize the flowering fallows in favour of the honeybee ?**

✧ Pollens

The sampling of pollen pellets allowed to identify plants visited by bees. A **database** was established of 153 samples, 1954 lines and 144 types of pollens [3].

➔ In 2006, the proportion of pollens coming from sowed fallows was dependent on the landscape context (ANOVA, P=0.002; no effect region): phacelia pollen reached 91% in a homogeneous landscape (Centre), against 7% in a more complex landscape (Midi-Pyrénées). However, this relation was not verified in 2007 with Fabaceae sowed.

✧ Study regions and study sites

The study was conducted in 2006 and 2007 in France. Four study regions (Rhône-Alpes, Midi-Pyrénées, Poitou-Charentes, Centre) are characterized by intensively managed agricultural areas. In each region, **two zones of study** were selected: **one with an flowering fallow** (2-4 ha) in its centre and **another without flowering fallow**. An apiary was installed at the centre of each zone. Both apiaries were distant from at least six kilometers.

✧ Landscape context

Landscape context was quantified using intensive field inspections at radius of 1500 m. Habitats types were classified: arable lands, grasslands, fallow fields, hedgerows, forests. To characterize landscape context we calculated for each site the percentage of semi-natural habitats (herbaceous covers, forest, hedgerows).

➔ The study sites covered **differents levels of landscape context** from structurally simple (Centre) to structurally rich landscapes (Midi-Pyrénées), with intermediate context (Rhône-Alpes).

Quantifying landscape context

✧ Plant covers

We tested **43 plants species**, 8 commercial mixtures and 10 mixtures established for the project. We identified the qualities and the limits of covers sowed according to: rate of emergence, ground cover, rate of adventitious, blooming, foraging activity by honeybees, opinion of farmers.

➔ We advise a **mixture with one annual plant** with fast growing (phacelia, mustard) and **pluriannual plants, in particular Fabaceae** (e.g. *Melilotus alba*, *Onobrychis sativa*, *Medicago spp.*, *Lotus corniculatus*) This mixture can supply good ground cover and a long flowering period for two seasons.

➢ Bibliographie

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✧ Colonies

Apiaries was constituted from 10 to 12 hives. Apiaries were completely renewed from one year to the next. We measured the brood surfaces, the hive weights and the honey yields.

➔ No effect of the region, the landscape or the flowering fallow was measured in 2006 (ANOVA after arcsin$\sqrt{p}$ transformation where p is a proportion, P>0.05). In 2007, hives benefiting from flowering fallows had brood surface (P=0.02) and weight (P=0.03) more stables between before and after the place of hives on sites than control hives. No effect of flowering fallows on the honey yield was measured.

Apiary	Brood surface after blooming - brood surface before blooming (cm²)	Hive weight after blooming - hive weight before blooming (kg)	Honey yield (kg)
With fallow	357.8 ± 276.8 [a]	-0.82 ± 5.78 [a]	24.1 ± 11.7 [a]
Without fallow	-807.9 ± 320.4 [b] N=30-32	-4.09 ± 6.31 [b] N=24-25	22.8 ± 14.3 [a] N=23-25

Melilotus

Warning !

Exotic plants sowed in fallows are often chosen for having bright colours (e.g. centaurea, cosmos, eschscholtzia). But their interest is still poorly known for the honeybees. They can be invasive, return in competition with native plants, impoverishing the vegetable biodiversity.

Phacelia

Study site with flowering fallows

✧ Conclusion

The flowering fallows were highly visited by honeybees for pollen sources. No incidence of the flowering fallows on the development of the colonies was measured when their blooming was restricted to 2-3 weeks (phacelia or mustard). Colonies close to a plurispecific sowed fallows, blooming over approximately 2 months (Fabaceae), had a weight and a brood surface significantly more stables. **Thus, appropriately managed fallows within intensively farming areas can allow abundance of pollen sources that can benefit to honeybees' colonies.** However, the effects on beekeeping yields, or on bee health, remain to specify.

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