

# Pollen resources of *Apis mellifera* in a rural landscape of North-Western France

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## Introduction

The honeybee is remarkably skilled in orientation and memorization of food resources, identified through plant color, odor and morphological traits. Foraging activity is also determined by the needs of the colony (resource input, quantities needed, stock status...) (Louveaux, 1958; Hügel, 1962; Blütghen and Klein, 2011). Recent environmental upheaval due to changing landscapes (Burel and Baudry, 1990; Macdonald and Johnson, 2000; Robinson and Sutherland, 2002; Le Féon et al., 2010), pest control pressure (Guzmán-Novoa et al., 2010; Higes et al., 2010; Core et al., 2012) and agricultural intensification (Baessler and Klotz, 2006; Carvalho, 2006) can impact honeybee colony development and survival by reducing or altering food resources. The aim of this study was to evaluate pollen resources in agricultural areas and determinate the foraging strategies of honeybee colonies in these areas to evidence possible effects on colony development and survival.

But does it exist an optimal flower map which would bring enough of the necessary pollens throughout the beekeeping season for a good development of the colony?

How could we install a sedentary apiary in rural landscape?

Which resources would be privileged knowing that the cultivated plants vary from year to year?

Only a few studies have already examined the honey bee resources in rural landscape. Then, we realized a study to try to respond to these questions with these objectives:

- evaluate the pollen resources in rural landscape
- determinate the foraging strategies of honey bees
- determinate which resources would be privileged

## Materials and methods

The study was performed in 2 apiaries in France in Region des Pays de la Loire (Figure1), in twenty colonies, ten for each apiary.

These apiaries are located in rural landscape and particularly in cultivated landscape

The monitoring was realized on two beekeeping seasons (2011 and 2012).

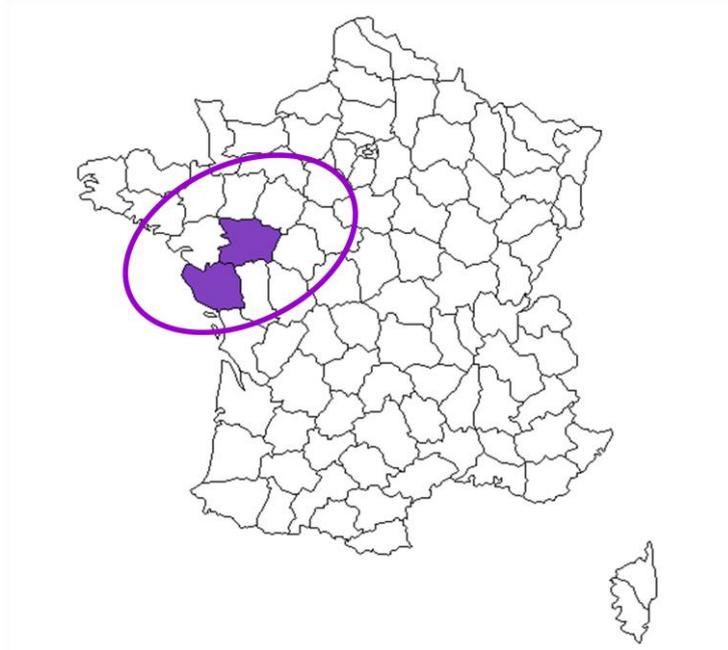


Figure 1: Location of the apiaries.

The botanical inventories were performed in foraging areas fixed to 1.5 km around each apiary which is the mean foraging distance suggested in literature (Steffan-Dewenter and Kuhn, 2002; Villanueva, 2002) with a variability linked to resources type (nectar, pollen, water) or season and location of resources (Beekman and Ratnieks, 2000; Visscher *et al.*, 1996).

We identified the landcover, the family and species of plants present in homogeneous entity, the abundance of plant with the Braun-Blanquet system (Poore, 1955) and the plant phenology.

Meanwhile, a laboratory analyzed the samples of pollen pellets for each colony (Von der Ohe *et al.*, 2004).

The inventories and pollen samples were realized:

- Twice per month from April to September 2011 and 2012
- Once per month from September 2011 to April 2012 and from September 2012 to October 2012

For information, the weather and the rate of brood production during the beekeeping season in North-Western France (Figure 2).

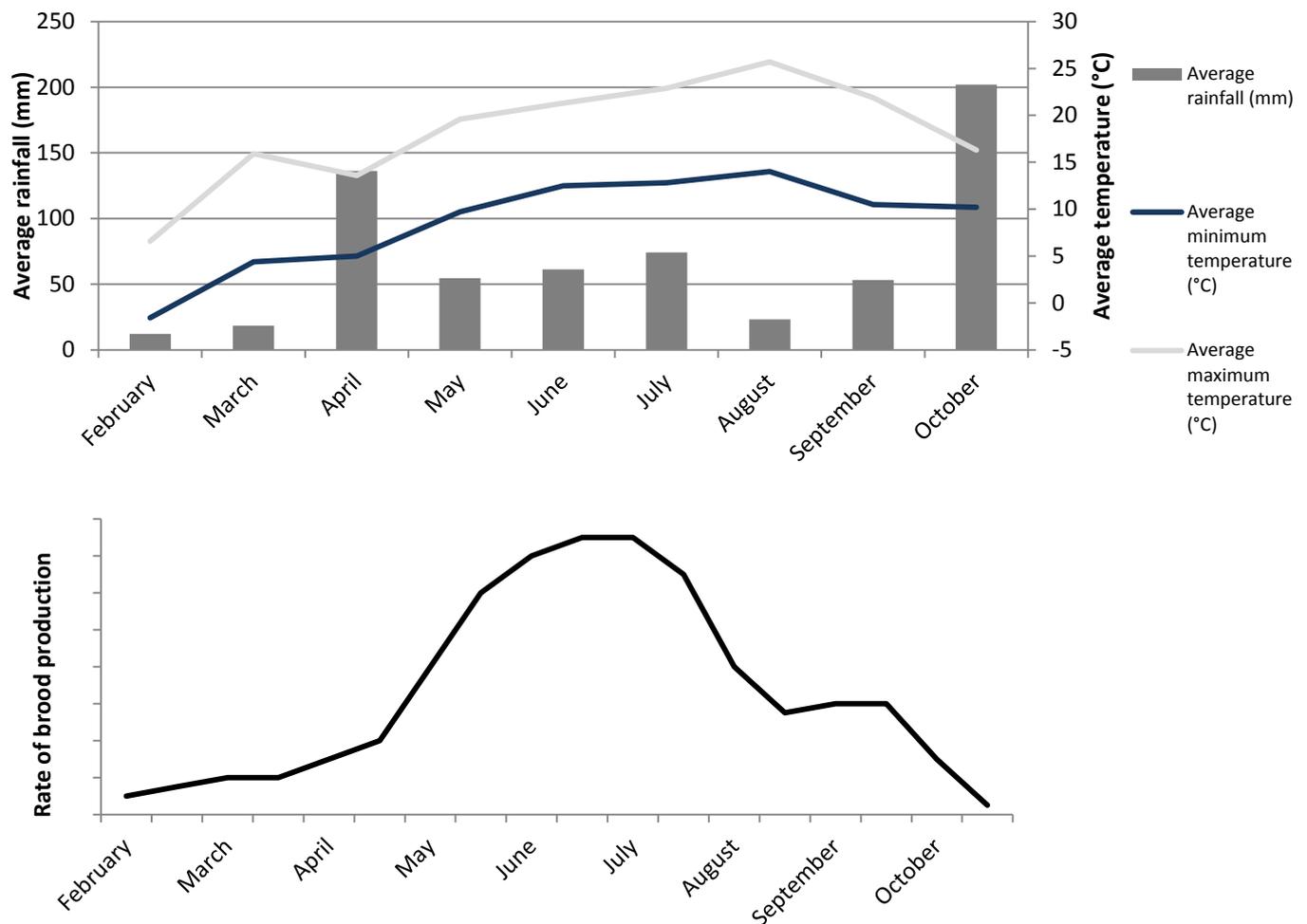


Figure 2: The weather (2012) (Source: MétéoFrance) and the rate of brood production (Source: Traité d'Apiculture Rustica) during the beekeeping season in North-western France

It's important for honey bees, to find pollen resources from April to September.

## Results

We have chosen to present the first results for one apiary on beekeeping season 2012.

In foraging area, the botanical inventories have permitted to identify 53 families and 159 species.

Considering the landcover data (Table 1), the foraging area was constituted of:

- 48.9% of cultivated areas with wheat, maize and sunflower,
- 22.4% of natural grasslands, ditches and roadsides with grasses, dandelion and clover,

- And 6.3% of woods, copses and hedgerows with oak, poplar, alder, blackberry, sloe.

**Table 1: Characteristics of the apiary foraging area: composition (cultivated areas, grasslands, ditches and roadsides, wood, copse and hedgerows, urban area, and others [%]) and principal species present in each category.**

Variables	Part of the foraging areas	Species
Cultivated areas	48.9	Wheat, maize, sunflower
Natural grasslands, ditches and roadsides	22.4	Grasses, dandelion, clover
Woods, copses and hedgerows	6.3	Oak, poplar, alder, blackberry, sloe
Urban areas	7.9	Ornamental sloe, roses
Others	14.5	–

A factorial multiple analyses has permitted to show a significantly correlation between botanical and palynological data.

We can note that the number of taxa in grasslands, ditches and roadsides and in woods, copses and hedgerows was higher than the number of taxa in cultivated areas.

We can observe a number of botanical taxa much higher than the number of pollen taxa. The number of botanical taxa evolved to a maximum in May and June while pollen taxa increase with a less important factor.

Considering the percentage of flowering surface, the species in woods, copses and hedgerows were more present at the beginning of the beekeeping season. The species in grasslands, ditches and roadsides were more present at the beginning and at the end of the beekeeping season. And the cultivated species dominate from the second half of April to the second half of August.

In palynological analyses, 52 families and 102 taxa have been found. The different profiles of honey bee colonies were identical with main pollen but differentiate themselves by the minority pollen. A profile was realized during the beekeeping season for the apiary. We can note the presence of a certain diversity of resources which is not linear, considering the succession of different species.

We can see that the cultivated species dominate the foraging area from April to August. Also the pollens gathered by honey bees, like *Fabaceae*, *Phacelia*, *Helianthus*, were only present since April with a low diversity until July and could vary each year. The wild resources in grasslands, ditches and roadsides were available throughout the season. The wild pollens gathered by honey bees like *Veronica*, *Taraxacum* or *Trifolium* were present from February to the end of the beekeeping season with a low diversity in the beginning of the season. The wild resources available in woods copses and hedgerows like *Corylus*, *Salix*, *Castanea*, *Rubus*, were present throughout the season but on the bigger flowering surface at the beginning of the beekeeping season. Similarly, the pollens gathered by honey bees are more important at the beginning of the season, present throughout the season but a few species were identified in August and at the beginning of September.

In summary, from February to July, the exploitation of wild resources dominates and after, the honey bees gather wild and cultivated species.

In our results, the diversity of resources in foraging area is important even though the cultivated areas dominate.

The diversity of pollens gathered by honey bees is also important with the presence of main pollens.

We have also noted that the cultivated species gathered by honey bees are not continuous during the season differently to wild species.

Finally, a lot of species present in the profile come from hedgerows, woods and copses.

## **Discussion and conclusion**

In cultivated landscape, the cultivated areas are more important than wild areas but we have seen in our results that the wild resources are much more exploited by honey bees.

The presence of wild species in cultivated landscape is important but:

- The self-propagating plants can be removed by pesticides ([Freemark and Boutin, 1995](#)),
- And the species in grasslands and roadsides which can be mowed or grazed ([McLaughlin et al., 1995](#)).

There remains the species in ditches which are not necessarily attractive for honey bees and wild sustainable species in hedgerows, copses and woods which have to be preserved.

These sustainable species ensure the pollen resources during the beekeeping season and for future seasons.

An absence of woods, copses and hedgerows in cultivated landscape would entail a low diversity of resources at the beginning of the beekeeping season and an impact on the development of the colony

And then, it's important for the beekeepers to be careful for the installation of apiaries.

Moreover, territorial audits can be envisaged to optimize the location of honey bee colonies.

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