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A study on the pollen sources for honey bees in Udine province (northern Italy)

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Abstract

The most important pollen plants (in northeastern Italy) were identified at the end of March 2003. In this period pollen loads were collected, grouped according to colour and 142 slides prepared. Using an optical microscope, the different plant pollens were identified. The relationship between pollen load colours and pollen plants was studied; pollen plants that were preferentially visited by honey bees were identified. *Taraxacum officinale* Weber, *Fraxinus*, *Salix*, Liliaceae races and *Populus* resulted the most important pollen plants, in this area. Bee crops often consisted of different pollen types.

Key words: pollen loads, pollen load colours, pollen plants, pollen load traps.

Introduction

Pollen is an important food resource for insects (Sawyer, 1981; Quaranta *et al.*, 2004), especially for the honey bees (Barbattini, 1991), because without it the family cannot increase and prepare to produce honey.

Therefore, at the beginning of the spring, foragers usually gather pollen. Collected pollen is used in different ways; some pollen is used to breed brood and some is stored in the hive for future uses (Ricciardelli D'Albore and Intoppa, 2000; Bassignani, 2002).

This article reports about the pollen loads collected by bees during 2003 in an hilly area in northeastern Italy, to identify which plants are more important for the honey bees during the first days of colony resume.

During the period March to September 2003 in the same area, field observations were also carried out, which allowed to identify the most important nectar plants (Fortunato *et al*., 2006).

Materials and methods

Four areas in the province of Udine (northeastern Italy), each surrounding an apiary, were studied. Apiaries were located in San Daniele del Friuli, Cornino (Forgaria del Friuli), San Mauro (Rive D'Arcano) and Ragogna del Friuli. The area, taken in consideration, had a ray of about 1.5 Km from each apiary.

At the end of March 2003, for 11 consecutive days (20^{th} - 30^{th} March), pollen loads from *Apis mellifera* L. (Hymenoptera Apidae) foragers were collected using pollen load traps. One pollen load trap was placed in front of the entrance of one beehive, in each apiary, and it was moved, the day after, to a different beehive. When the bees returned "home", they had to pass across the grill of the trap, their pollen loads fell down in the box below, and were collected (Frilli *et al*., 2001). Pollen load traps were moved everyday from one hive to another, since otherwise honey bees learn how to overcome the trap and, therefore, the harvest diminishes during the days.

The box contained a mixture of pollen loads with different colours. Therefore pollen loads were separated according to colour: yellow, orange, grey, green, black, red, brown and white.

When pollen loads were dry, each different colour group was put in a separate container; all of them were weighted and, later, slides were prepared.

A slide was prepared from each colour group of pollen loads (Louveaux *et al.*, 1978) and it was observed under optical microscope, so the botanical essences in the apiary surroundings were identified (von der Ohe and von der Ohe, 2000). We adopted the nomenclature of pollen type according to Louveaux *et al*. (1978) and Persano Oddo and Ricciardelli D'Albore (1989).

The method includes the following steps:

- collection of pollen loads with a pollen trap;
- classification of pollen loads according to colour;
- study of their composition in term of pollen species;
- analysis of the relationship between colour and composition.

The nomenclature of plants was adopted according to Pignatti (1982) and Poldini *et al*. (2002).

Results and discussion

In table 1 the plants and the pollens forming the pollen loads came from are listed.

It can be observed that, in the same period, different colonies from the same apiary gathered pollen loads from different plant species; for example on the 20^{th} of March, in San Mauro, bees gathered only *Corylus* pollen, but, the day after, they gathered four different pollen types, i.e. *Populus*, *Salix*, Liliaceae and *Taraxacum*. The place in which bees collected the most different pollen types was Cornino; in fact, here, on the 26^{th} of March, they collected 7 different pollen types, i.e. *Fraxinus*, Magnoliaceae, *Fraxinus* + *Populus*, *Allium*, *Taraxacum*, Liliaceae and *Papaver*. Three times, in 3 different places, all the pollen loads (100%) consisted of *Salix*, and in 2 places of *Taraxacum*. There were also pollen loads made up only of *Corylus*, Cruciferae (*Sinapis* s.), *Fraxinus* and *Papaver*.

Table 1. Pollen types identified by pollen analysis (C = Cornino; R = Ragogna; SD = San Daniele; SM = San Mauro. Results are given in percentage).

Date and place	Pollen's types																		
	Fraxinus	Liliaceae	Magnoliaceae	*Papaver*	*Populus*	*Prunus*	Ranunculaceae (*Ranunculus*)	*Salix*	*Taraxacum*	*Ulmus*	*Acer*	Cruciferae (*Sinapis* s.*)	*Allium*	*Calystegia*	Caryophyllaceae (*Silene* s.*)	*Colchicum*	*Corylus*	*Crataegus*	Ericaceae
20/3 C	10						6.7		4.5		76.3					0.01		1.5	
20/3 R																			
20/3 SD	28.5			7.6					3.8	0.5					59.6				
20/3 SM																	**100**		
21/3 C								82.5	17.5										
21/3 R												**100**							
21/3 SD				**100**															
21/3 SM		3.3			61.6			34.3	0.8										
22/3 C								70	30										
22/3 R								**100**											
22/3 SD								**100**											
22/3 SM	8	6.3			28.5			57.2											
23/3 C	2.7			0.9					85.1					11.3					
23/3 R									**100**										
23/3 SD	**100**																		
23/3 SM								**100**											
24/3 C	72.8	4.4		0.2			12.2	2.3	8.1										
24/3 R	45.1	14.4	36.1					2.1	2.3										
24/3 SD	45.5									54.5									
24/3 SM					37.8			62.2											
25/3 C	75.6	1.6		4.6	7				11.2										
25/3 R		3.1		16.8				76.8	1									2.3	
25/3 SD	93.5								6.5										
25/3 SM	82.2				12.3			5.5											
26/3 C	80.4	3	8.7	0.1	6.1				2				2.4						
26/3 R	78.6	2.3	10		7				2.1										
26/3 SD	92.4					4.4			3.2										
26/3 SM					37.8	3.4		58.8											
27/3 C	52	8					27	6.9	13.3										
27/3 R	85.4	1.5							0.9				12.2						
27/3 SD	80								4.8			15.2							
27/3 SM	37.4				19.1			35.6	4.7			3.2							
28/3 C	53.3	2.3					4.6		14.3										25.5
28/3 R	59.8	1.9				6.9	29.4		2										
28/3 SD								2.6			49.6	47.8							
28/3 SM	48						29.6		12.9		9.5								
29/3 C									**100**										
29/3 R	69.2								17.6	13.2									
29/3 SD						21.9		55.1	23										
29/3 SM						30		31.9		38.1									
30/3 C					41.5		9.5	10.8	38.2										
30/3 R		1.3			71.2			7.2	12.3				8						
30/3 SD						17			44			39							
30/3 SM									26.2					61				12.8	

* "s." (means shape) is used when it is not possible to ascertain the exact species the pollen belongs to; in these cases more general categories, based on groups, shapes and types, are used.

Bees often visited *Fraxinus*, *Salix* and *Taraxacum* for pollen. In particular *Fraxinus* seems to be very important in Cornino and San Daniele; there on the 23rd of March, this species was the only plant from which bees gathered pollen. Moreover *Fraxinus* pollen was collected by bees in all four places on the 27th of March, and on that day pollen loads were made up almost entirely by this pollen.

Also *Salix* pollen was very important for bees, in fact on the 22nd of March, bees gathered it in all four places.

Taraxacum pollen was often collected by bees especially in Cornino and Ragogna, and represented the entire crop on the 23rd of March in Ragogna, and on the 29th of March in Cornino.

In a few cases a principal species representing the main part of the crop was found, while several secondary species were noted. The latter consisted of Liliaceae (in particular *Allium* and *Colchicum*) in Cornino and Ragogna, *Papaver* in nearly all sites, Ranunculaceae including *Ranunculus* was particularly abundant in Cornino instead *Prunus* in San Daniele.

Some plants were visited for pollen only in certain places; for example Cruciferae pollen was gathered by bees principally in San Daniele, and *Populus* pollen in San Mauro.

A total of 142 slides were classified into eight colour classes. On the whole 19 different types of plants were proved to contribute to the framework of the pollen loads (table 2).

Orange pollen loads: all the pollen grains were identified as *Taraxacum*.

White pollen loads: this group included pollen belonging to different families among which Liliaceae and Magnoliaceae, in particular *Allium*. Other plants, which have the same colour of pollen grains, belong to Salicaceae (*Populus*) and Ulmaceae (*Ulmus*) families.

Yellow pollen loads: *Salix* and *Fraxinus* showed this colour and sometimes races of Caryophyllaceae family. In some cases also *Calystegia* and the Ranunculaceae family produce the same colour of pollen grains.

Grey pollen loads: races of Ranunculaceae and, in a few cases, pollen grains from Cruciferae and Magnoliaceae have this colour.

Brown pollen loads: pollen loads with this colour were found to contain pollen grains of plants belonging to different genera, for example *Acer*, *Papaver*, *Corylus* and *Prunus*; *Populus* and, in a few cases, the Cruciferae and Liliaceae families, were also represented.

Black pollen loads: these pollen grains belonged to races of Liliaceae and in particular *Colchicum*; sometimes even *Papaver* presented this colour.

Red pollen loads: *Papaver* sometimes showed this colour.

Green pollen loads: this group included pollen grains belonging to *Crataegus*, which presents only this colour, and in a few cases *Acer* and *Calystegia*. Sometimes even *Fraxinus* and *Salix* were present.

Data obtained from microscopically observations can lead to some considerations. 29 slides, prepared from orange pollen loads, were classified as *Taraxacum*. Out of 22 slides, identified as *Fraxinus*, 19 came from yellow pollen loads, 2 from green pollen loads and the last one from brown pollen loads. In the literature *Fraxinus* pollen loads are defined yellow (Simonetti *et al*., 1989); in this case differently coloured pollen loads, probably depends on various type of pollen being present in the same load.

Table 2. Variability of the pollen load's colour.

Botanical family or botanical genus	Total	Colours of pollen loads							
		Orange	White	Yellow	Grey	Brown	Black	Red	Green
Acer	3					2			1
Allium	3		3						
Calystegia	2			1					1
Caryophyllaceae (*Silene* s.*)	1			1					
Colchicum	1						1		
Corylus	1					1			
Crataegus	3								3
Cruciferae (*Sinapis* s.*)	5		2		1	2			
Ericaceae	1					1			
Fraxinus	22			19		1			2
Liliaceae	13					2	11		
Magnoliaceae	3		2		1				
Papaver	7		1			3	2	1	
Populus	11		5		1	4			1
Prunus	5			1		4			
Ranunculaceae (*Ranunculus*)	7		3	1	3				
Salix	21		1	14					6
Taraxacum	29	29							
Ulmus	4		3			1			

* "s." (means shape) is used when it is not possible to ascertain the exact species the pollen belongs to; in these cases more general categories, based on groups, shapes and types, are used.

Table 3. Comparison between the colours of the sampled pollen loads and literature data: data according to literature (top) and data do not according with literature (bottom).

Botanical family or botanical genus	Colours of sampled pollen loads	Colours of pollen loads referred in literature (Simonetti *et al*., 1989)
Acer	Brown-Green	*A. pseudoplatanus* L.: brown-green
Allium	White	*A. cirrhosum* Vandelli: colour-less
Caryophyllaceae (*Silene* s.*)	Yellow	*Silene dioica* (L.) Clairville: yellow
Crataegus	Green	Yellow-Green
Fraxinus	Yellow	Yellow
Magnoliaceae	White-Grey	*Liriodendron* : white
Papaver	Brown-Black-Red	*P. rhoeas* L.: red; black
Prunus	Brown	Brown
Salix	Yellow	*S. alba* L., *S. triandra* L., *S. caprea* L.: yellow
Taraxacum	Orange	Orange
Calystegia	Yellow-Green	White-Grey
Colchicum	Black	Orange
Corylus	Brown	Yellow-Green
Cruciferae (*Sinapis* s.*)	Brown-White	Yellow-Brown
Ericaceae	Brown	*Erica*: white-grey
Liliaceae	Black	Red
Populus	White-Brown	Brown
Ranunculaceae (*Ranunculus*)	Grey-White	Yellow-Light yellow
Ulmus	White	Pink-Yellow

* "s." (means shape) is used when it is not possible to ascertain the exact species the pollen belongs to; in these cases more general categories, based on groups, shapes and types, are used.

Careful observations using optical microscopy showed that a load, containing mostly *Fraxinus* pollen, became green if it also contained *Papaver* or *Populus* pollen; in contrast it became brown, if *Fraxinus* pollen was mixed with *Ulmus* pollen.

Possibly, the same phenomenon occurs for *Salix*, because, in the literature, *Salix* pollen loads are classified as yellow (Simonetti *et al*., 1989), but here they were found in pollen loads of different colours, probably depending on the presence of different pollens in the same load. Indeed loads, which contained mainly *Salix*, became green if the pollen was mixed with *Taraxacum* and *Acacia dealbata* Link pollen or with *Acer* and Ranunculaceae pollen or only with *Populus* pollen. On the other hand the pollen load became white when it was mixed with Ranunculaceae pollen (and in particular with *Ranunculus* genus).

Papaver showed a range of pollen load colours greater than other genera. Out of the 7 slides, containing *Papaver* pollen, 1 came from white pollen loads, 3 from brown pollen loads, 2 from black pollen loads and the last from red pollen loads. The literature cites red or black pollen loads for this genus (Simonetti *et al*., 1989), consequently when pollen loads showed different colours, it probably depends on the presence of other pollens: loads containing mainly *Papaver* pollen became brown if mixed with pollen from *Taraxacum – Fraxinus*. In contrast, pollen loads became white if *Allium* pollen was present.

Populus pollen in the literature is described as brown (Simonetti *et al*., 1989), so when they showed different colours, it depended on the presence of different pollen in the same load. In particular pollen loads became grey if *Populus* pollen is mixed with *Allium* pollen, but became green if mixed with *Salix* pollen. Loads became white with *Ulmus* pollen in the load, or with the mix *Ulmus – Taraxacum* or *Ulmus – Allium*.

Concerning the pollen load colours, a comparison was made between empirical data and those quoted in literature. The results are shown in table 3.

The great colour differences, found between experimental and literature data could be justified by the presence of different pollen types in the same load, or, sometimes, because only pollen of the genus and not of the species was known. In fact, it is possible to encounter great pollen load colour differences between species. For example in the Caryophyllaceae family *Silene dioica* (L.) Clairville produces yellow pollen grains, while in *Silene alba* (Miller) Krause pollens are grey.

The colour of pollen load comes from pollen colour, but it can change depending on different pollen types mixtures in the same load, or owing to atmospheric moisture or substances added by bees, when they make up the loads. All these factors have an influence, so they can change the original colour of pollen loads (Bassignani, 2002).

Conclusions

The data allow to draw some conclusions:

- the polliniferous plants always harvested by bees, in the beginning of the spring in the studied area, are *Taraxacum officinale* Weber, *Fraxinus*, *Salix*, Liliaceae and *Populus*;
- an important pollen source, for bees, was the Liliaceae family, which is widely diffused especially in Ragogna and Cornino;
- other important pollen sources, not noted during

the field observations, were *Ulmus* and *Sinapis* s.;
- this study shows pollen types which honey bees gathered at the beginning of the active season when a lot of energy is needed. It is not know why honey bees have chosen them, a study of grains composition will be useful to identify the factors (i.e. protein contents) which influence forager's choices.

It must be underlined that crops rarely consist of only one pollen type, probably because bees need a varied diet to prevent beehive illnesses (Ricciardelli D'Albore and Persano Oddo, 1978).

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