

The capture media in aerobiological sampling

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Abstract

In this paper a comparative study of different adhesive media used with the impaction suction sampler have been done. The sampling was carried out by means of a Burkard spore trap and a double-blind comparison of vaseline, petrolatum white and silicone fluid (silicone/carbon tetrachloride) was done. With the aim to compare the adhesive efficiency with different pollen grain sizes and shapes, some different pollen types were used. Moreover, in order to compare the media under different weather conditions the sampling was done outdoors, in different seasons. The differences in the efficiency of these media were small, but occasionally significant. These differences depend on the climatic conditions as temperature influences vaseline adhesivity. In conclusion, we suggest the utilization of silicone fluid because of its stability to temperature and its easy application. © 1997 Elsevier Science Ireland Ltd.

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1. Introduction

Techniques of solid particle sampling in impaction samplers and impaction suction samplers require that the particles strike and adhere to a surface which is later microscopically examined. Therefore, when performing a sampling, it is important to select not only the most adequate apparatus but to use the most efficient adhesive substance as well, taking into account such characteristics as the size of the particles to be sampled and the local climate.

Currently a wide variety of adhesives exists which are used in various locations for aerobiological sampling with suction samplers. In Spain, the most widely utilized has always been vaseline. In some sites in our country vaseline has been used, and in others petrolatum white, recommended by Burkard Manufacturing Co. In general terms, the melting point of all of these

vaselines is between 38–60°C. The problem of the use of different kinds of vaseline, apart from the thickness of the layer of adhesive and the technique in which they are spread on the Melinex strip, is due to the fact that their viscosity and adhesivity depend on ambient temperature.

The Italian Aerobiology Network (AIA), recommends silicone fluid as capture media. This substance has stable physical characteristics of between –20 and +150°C.

Other adhesives in use, such as glycerol, glycerol jelly and gum are, in general, of unknown composition for the aerobiologist. In other countries, other adhesive substances composed of a mixture of products are used; but it is always preferable in these cases to utilize a commercial product so as not to introduce new errors.

When the Spanish Aerobiology Network (REA) was set up in 1992, one of the main goals was to standardize methods in order to improve the comparability of its measurements; for example, the use of a volumetric suction sampler and the use of the same adhesive

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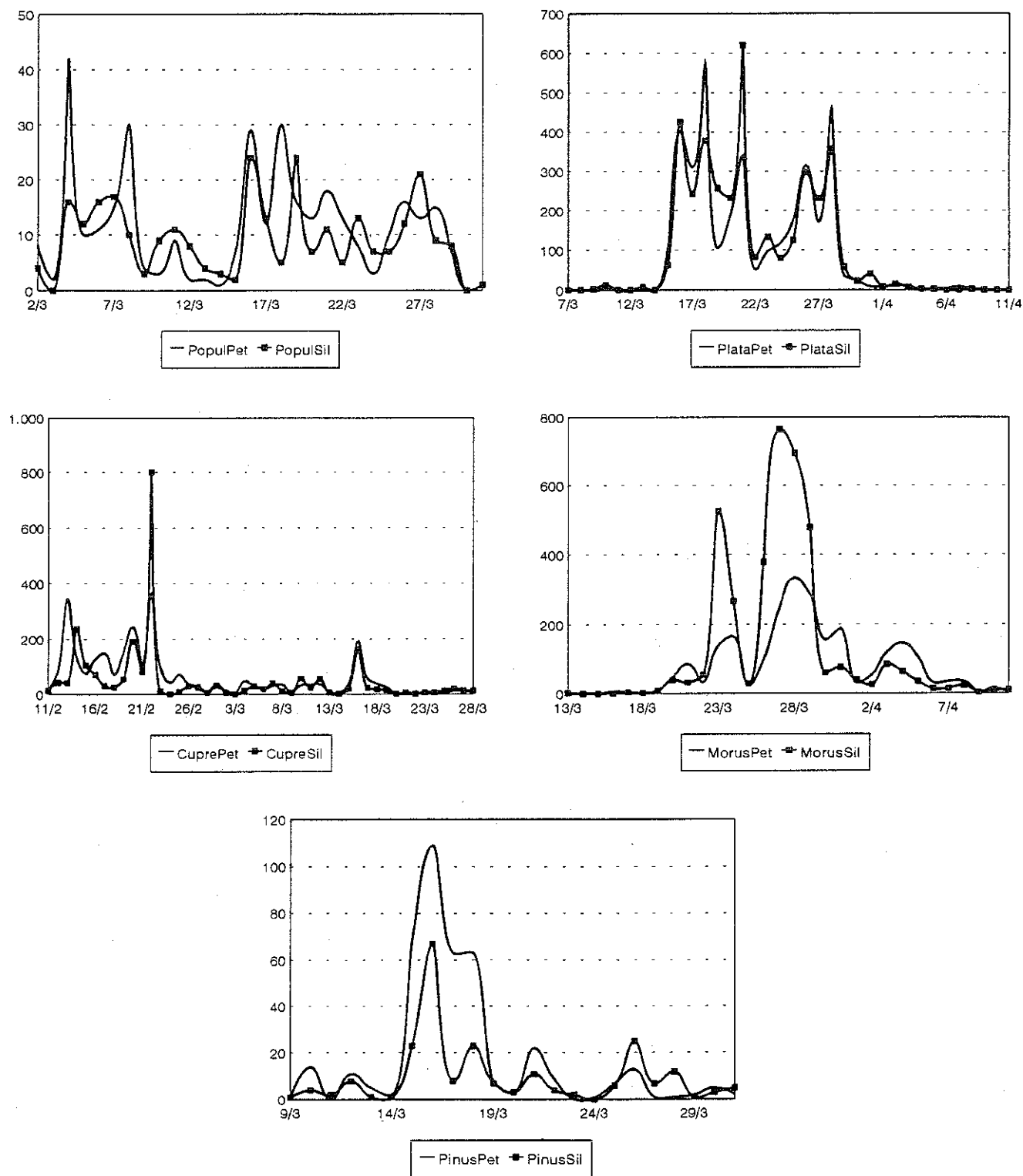


Fig. 1. Winter daily pollen counts comparing petrolatum white and silicone fluid. Different pollen types: *Populus*, *Platanus hybrida*, Cupressaceae, *Morus* and *Pinus*.

substance by all of the centres belonging to the network. Because of this, the first objective of the Coordinating Centre of the Spanish Aerobiology Network,

located in Córdoba, was to perform a comparative study of different adhesive media in order to recommend the best one to all the members of the network.

Table 1
Correlation analysis comparing pollen count with different media (petrolatum white and silicone fluid) in winter

Taxon.	N	Petrolatum/silicone correlation
<i>Populus</i>	60	0.2078
<i>Platanus</i>	60	0.8630**
<i>Cupressaceae</i>	60	0.8094*
<i>Morus</i>	60	0.9463**
<i>Pinus</i>	60	0.6465

* 0.01.

** 0.001.

Since utilizing a good adhesive means doing a good survey, and the data obtained from the sampling should be comparable, it would be best to utilize an adhesive that does not vary with different meteorological conditions.

2. Materials and methods

The comparative analyses have been done in Córdoba, a place with a typically Mediterranean climate, with some Continental influences: short and mild winters and long and very hot summers, with daily mean temperatures usually above 40°C.

The sampling was carried out using a Burkard spore trap. A double-blind comparison of vaseline, petrolatum white and silicone fluid was done. For this purpose, the tape on the drum was divided into two halves, which were coated with different adhesives applying them clockwise on the drum, in order to obtain two different surfaces on the same sample.

The results have been expressed as pollen grains per cubic meter of air.

With the aim of comparing the adhesive efficiency with different pollen grains sizes and shapes, some different pollen types were used. Moreover, in order to compare the media under different weather conditions the sampling was done outdoors, and in different seasons (winter, spring and summer). Thus, in winter, *Cupressaceae*, *Populus*, *Pinus*, *Platanus* and *Morus* were studied, in spring *Olea europaea*, *Poaceae* and *Chenopodiaceae-Amaranthaceae* for a very short period

Table 2
T-test analysis to compare the mean with different media (petrolatum white and silicone fluid) in winter

Taxon.	N	Petrolatum	Silicone	T	Prob.
<i>Populus</i>	34	2.34	2.17	-1.17	0.251
<i>Platanus</i>	23	4.08	4.20	-1.15	0.261
<i>Cupressaceae</i>	53	3.12	2.77	2.79	0.007
<i>Morus</i>	27	3.77	3.71	0.45	0.657
<i>Pinus</i>	19	2.23	2.02	1.02	0.322

of time, and in summer *Poaceae*, *Olea europaea*, *Helianthus*, and *Chenopodiaceae-Amaranthaceae*.

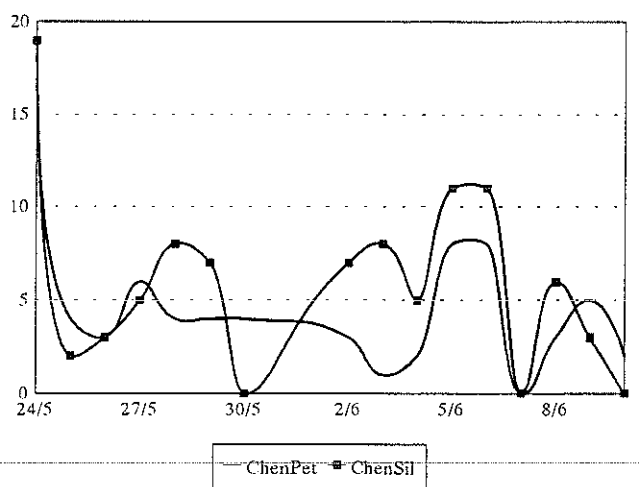
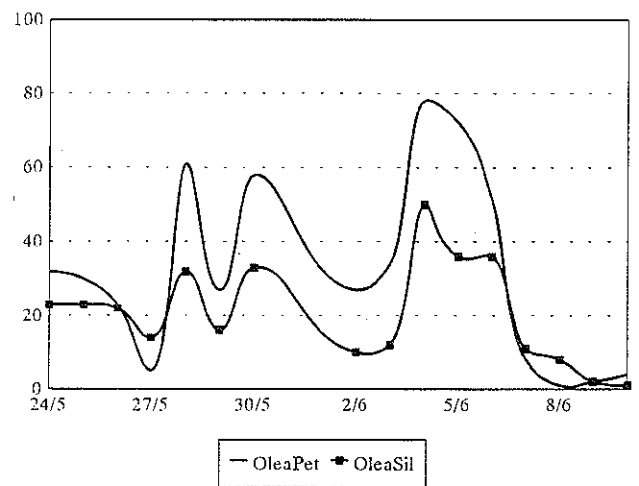
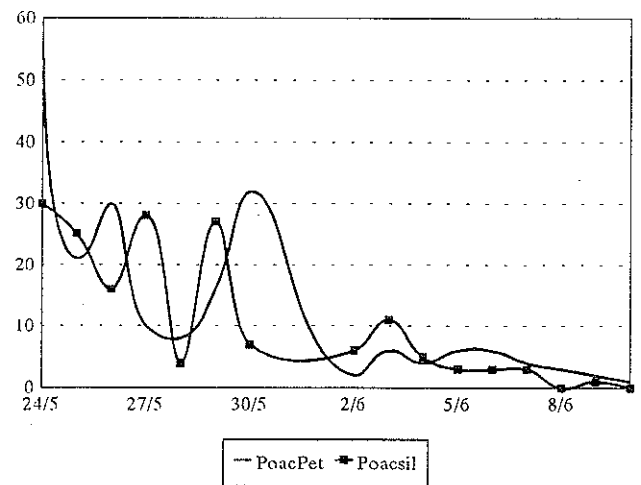


Fig. 2. Spring daily pollen counts comparing petrolatum white and silicone fluid. Different pollen types: *Poaceae*, *Olea europaea* and *Cheno-Amaranthaceae*.

Table 3
Correlation analysis comparing pollen count with different media (petrolatum white and silicone fluid) in spring

Taxon	N	Petrolatum/silicone correlation
Poaceae	14	0.9271*
<i>Olea europaea</i>	14	0.9689*
Chenopodiaceae- Amarathaceae	14	0.9028*

* 0.001.

A correlation analysis was carried out to correlate pollen count with different media in seasons with different temperatures in order to study the effect of the temperature on the capture efficiency.

To verify if significant differences exist between the means of all media a *T*-test was applied.

3. Results

In Fig. 1, where pollen counts with two different adhesives, petrolatum and silicone fluid, are represented, a significant difference in collecting efficiency was found. However, the data obtained from the Pearson correlation analysis show a covariance with a level of significance of 99.9% in *Platanus* and *Morus*, and 99% in *Cupressus* (Table 1). With respect to pollen grains of a medium size (*Cupressaceae*, *Populus*), or smaller but with a higher density (*Platanus*), fewer differences were found; however, significant differences in the collecting efficiency for some pollen types (the very large (*Pinus*) or small (*Morus*)) were found. A higher *Pinus* pollen count was detected with petrolatum compared to silicon fluid, and a higher *Morus* pollen count was detected with the latter (Fig. 1).

To verify if significant differences exist between the means of the media a *T*-test was applied (Table 2). The differences are statistically significant only in the case of *Cupressaceae*. It seems that when a taxa is present in the air for a longer period of time (as with *Cupressaceae*), there are likely to be more differences which will statistically result in a significant level.

This analysis was repeated in spring, but during a very short period of time, and *Olea europea*, *Poaceae* and *Cheno-Amaranthaceae* pollen types were detected

in the samples (Fig. 2). Pearson correlation analysis results show that these data are correlated with a degree of significance of 99.9% for all pollen types (Table 3). But, as can be seen in Table 4, there is a significant difference between the means of both media only in *Cheno-Amaranthaceae* pollen type.

Fig. 3 shows the curves representing pollen count catches carried out during the summer, with two different adhesives, vaseline and petrolatum, to study their collecting efficiency. We have considered those days with a mean temperature above 30°C (i.e. days with several hours with temperatures above 40°C; the melting point of vaseline is between 38 and 60°C) and those days with a mean temperature below 30°C. As can be seen in the Pearson correlation analysis (Table 5), if only the days with a mean temperature above 30°C are considered (Table 5A), then the data are not correlated, with the exception of *Helianthus*. The results of the *T*-test applied to compare the means (Table 6) shows that in general the difference between the means are higher on those days with a mean temperature above 30°C (Table 6A).

4. Discussion

The results of the analysis applied to data comparing petrolatum and silicone fluid reveal that there are significant differences in their pollen collecting efficiency. Larger pollen types are more efficiently trapped using petrolatum, whereas in the case of smaller types silicone fluid is the most efficient adhesive. This is probably due to the fact that petrolatum is a kind of vaseline with a higher melting point, is not easily smeared on the melinex tape and, to obtain a thin layer, it must be placed for a time in an oven at 60°C. Silicone fluid is an easy-to-use solution. The quantity of fluid utilized does not influence the thickness of the layer as the solvent evaporates quickly.

In relation to the question of adhesive efficiency and the possible standardization of their use, some comparative studies have already been done utilizing different media. Solomon et al. (1980) compared three media (silicone grease, petrolatum white and Lubriseal) using roto-slide samplers. They observed that the differences in the efficiency of these media were small, but occasionally significant. The best results were obtained with silicone grease and the worst with Lubriseal. Sub-

Table 4
T-test analysis to compare the mean with different media (petrolatum white and silicone fluid) in spring

Taxon	N	Petrolatum	Silicone	<i>T</i>	Prob.
Poaceae	16	1.90	1.81	1.6	0.560
<i>Olea europaea</i>	18	2.58	2.36	1.48	0.157
Chenopodiaceae-Amarathaceae	15	3.85	3.60	2.26	0.048

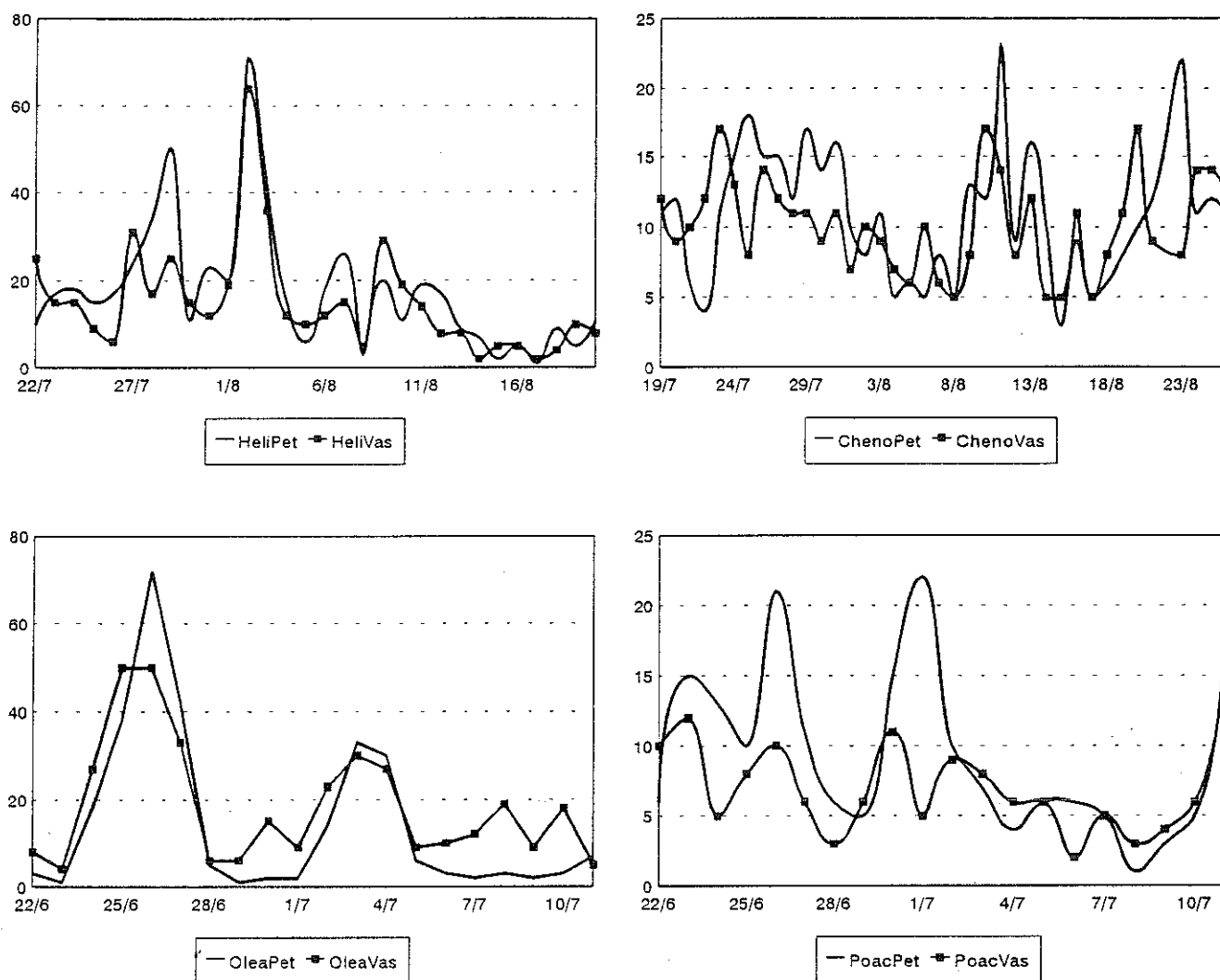


Fig. 3. Summer daily pollen counts comparing petrolatum white and vaseline. Different pollen types: *Helianthus*, Chenopodiaceae, *Olea europaea* and Poaceae.

sequently, Käpylä (1989) compared various adhesives, arriving at the conclusion that the most efficient might consist of a new formula containing polyvinyl alcohol, water, glycerol and lactic acid. Nevertheless, we believe that it is preferable to use a commercial product in order not to introduce new errors upon making the mixture. Very recently Comtois and Mandrioli (1994, 1997) have completed a comparative study of several adhesives; gelatine/glycerine, vaseline/hexane, silicone/carbon tetrachloride and paraffin. The differences between the various media were non-significant, although gelatine underestimated spore counts in comparison to silicone, but overestimated them if compared to vaseline or paraffin. For pollen counts, silicone and gelatine have shown similar results.

Table 5
Correlation analysis comparing pollen count with different media (petrolatum white and vaseline) in summer

Taxon	N	PET/VAS correlation
A. Days with mean temperature above 30°C		
<i>Helianthus</i>	22	0.7820*
Chenopodiaceae-Amaranthaceae	22	0.897
<i>Olea europaea</i>	22	0.2393
Poaceae	22	0.3707
B. Days with mean temperature below 30°C		
<i>Helianthus</i>	39	0.7460*
Chenopodiaceae-Amaranthaceae	39	0.6795*
<i>Olea europaea</i>	39	0.8253*
Poaceae	39	0.9106*

* 0.001.

Table 6
T-test analysis to compare the mean with different media (petrolatum white and vaseline) in summer

Taxon	<i>N</i>	Petrolatum	Vaseline	<i>T</i>	Prob.
A. Days with mean temperature above 30°C					
<i>Helianthus</i>	22	2.25	2.56	0.31	0.759
Chenopodiaceae-Amarathaceae	22	2.39	2.50	-1.01	0.323
<i>Olea europaea</i>	22	1.38	1.00	1.89	0.072
Poaceae	22	1.10	0.37	5.17	0.000
B. Days with mean temperature below 30°C					
<i>Helianthus</i>	39	1.77	1.73	0.37	0.710
Chenopodiaceae-Amarathaceae	39	2.37	2.38	-0.11	0.917
<i>Olea europaea</i>	39	1.34	1.41	-0.52	0.607
Poaceae	39	1.36	1.07	4.30	0.000

Given the results of prior studies and of the results obtained in this study, it could be inferred that the differences in the efficiency between adhesives are normally small. But, nevertheless, these differences exist and depend on the local climatic conditions. Petrolatum white seems to be the most efficient one, particularly in Córdoba, a city characterized by a Mediterranean climate with short, mild winters and long, hot summers. The most important goal when testing adhesives for dry aerosol is not so much high adhesivity, but their reliability when applied repeatedly during standard procedures.

In summary, taking into account the present investigation, the Spanish Aerobiology Network (REA) will utilize silicone fluid as the most reliable and easy-to-use capture media under extreme climatic conditions.

Acknowledgements

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