Aerobiologia **19:** 57–61, 2003.

A new adhesive for airborne pollen sampling in Spain

P. Alcázar, C. Galán*, P. Cariñanos & E. Domínguez-Vilches
Departamento de Biología Vegetal, División Botánica, Universidad de Córdoba, Campus Universitario Rabanales, 14071 Córdoba, Spain
*(*Author for correspondence: E-mail: carmengalan<bv1gasoc@uco.es)*

Key words: adhesive media, airborne pollen, Hirst sampler, self-adhesive tape

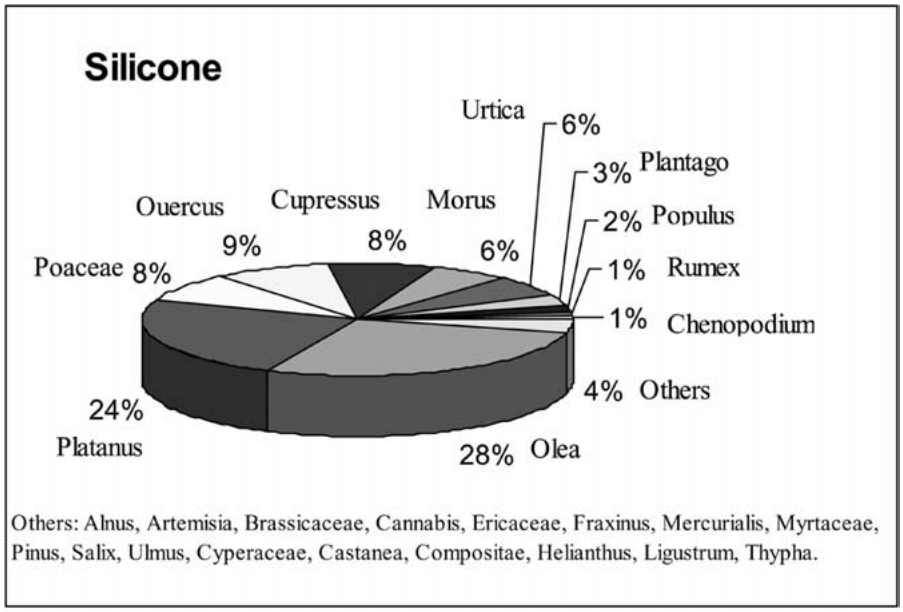
Abstract

The use of a double-sided self-adhesive tape for pollen trapping could offer some advantages over traditional adhesives, manually applied to the Melinex tape of a Hirst-type spore trap, since variation in terms of adhesive application is nil and additional effort in applying the adhesive is avoided. Nevertheless, its efficiency with respect to the standard adhesives must be tested. In Cordoba (southwest Spain), the Spanish Aerobiology Network Centre performed a series of comparative studies and recommended the use of a silicone fluid as an adhesive. This paper compares the efficiency of a double-sided self-adhesive tape (3M) with silicone fluid as adhesive. Sampling was carried out using a Hirst type 7-day spore trap located 15 m above ground level. A Melinex tape coated with silicone fluid covered one half of the weekly drum; the other half was covered with 3M tape that included the adhesive. It is widely reported that the physical characteristics of silicone fluid do not vary with temperature (Galán and Domínguez-Vilches, 1997), but this study showed that 3M efficiency did vary with temperature. The results revealed that 3M tape was less efficacious at low temperatures, while at high temperatures it becomes stickier. In contrast, silicone fluid does not vary with temperature. The efficiency of 3M tape also seems to be negatively influenced by rain.

Introduction

Nowadays many adhesives are being used for airborne pollen sampling with Hirst-type volumetric samplers. Some studies have been performed to prove their capturing efficiency (Solomon et al., 1980; Comtois and Mandrioli, 1997; Galán and Domínguez, 1997; Razmovski et al., 1998; Alcázar and Comtois, 1999). In most cases, the differences in adhesive efficiency are small. In southern Spain, where temperatures often rise above 40 °C, Vaseline does not appear to be a good adhesive due to its alterability with temperature (Galán and Domínguez, 1997). After a comparative study of different adhesive media, the Spanish Aerobiology Network Coordinating Centre recommended that all member centres use silicone fluid, which remains stable over a wide range of temperatures, thus ensuring standardization of methodology (Galán and Domínguez, 1997). This adhesive yielded good results in other studies, such as Solomon et al. (1980) and Comtois and Mandrioli (1997). Although easy to apply, a coated tape is commercially available, which avoids additional effort in application and also excludes the possible human error inherent in manual application. The commercial product is a double-sided self-adhesive acrylic tape (Scotch 3M 9425). 3M tape could become a standard adhesive used by different centres, since differences due to application of the adhesive by different operators would be eliminated. The adhesive was tested in Montreal (Canada) by Alcázar and Comtois (1999) and revealed higher capturing efficiency than the glycerine/gelatine coating traditionally used for capturing airborne pollen on the Melinex tape of Hirst samplers.

The aim of this study was to compare the efficiency of airborne pollen grain capture on double-sided self-adhesive acrylic tape (3M) with the silicone fluid used by the Spanish Aerobiology Network as a capture medium.



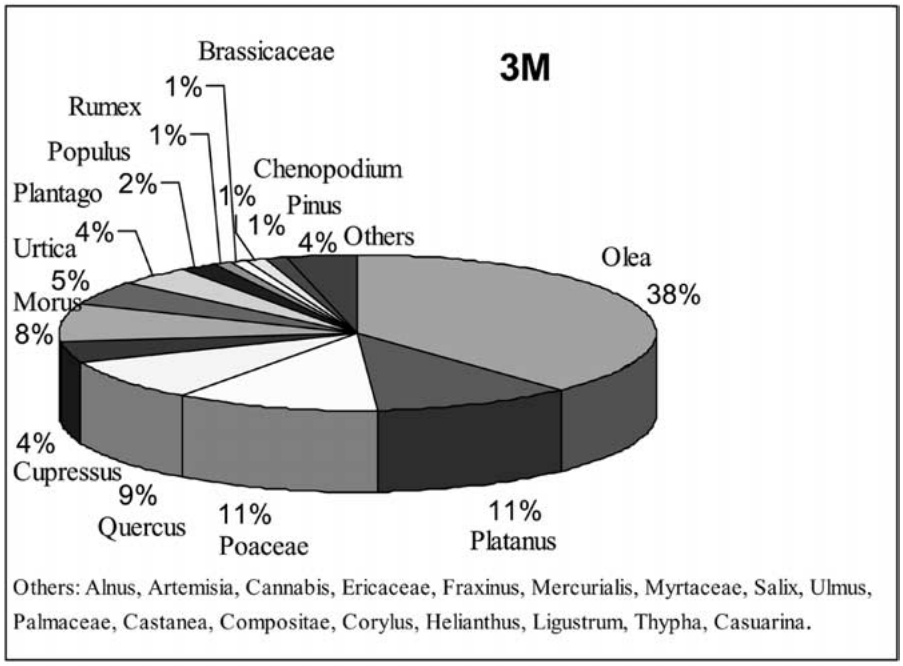


Figure 1. Pollen percentages of each taxon compared to the total pollen count with each adhesive.

Materials and methods

The study was performed in Cordoba (southwest Spain), a city with a Mediterranean climate characterised by cold rainy winters and dry hot summers (maximum temperature above 40 °C). Sampling was carried out using a Hirst type 7-day spore trap located on the roof of the Faculty of Science, 15 m above ground level. The study was carried out between 10 January and 19 June 2000. During this period, the temperature in the area ranged from −2 °C (minimum temperature recorded on 23 January) to 40 °C (recorded on 17 June). Half of the weekly drum was covered by Melinex tape, coated with silicone fluid; the other half was covered with 3M tape, which is a commercially available tape produced by 3M Scotch Brand (#9425). It is a high-tack/medium-tack acrylic adhesive with a high resistance to solvents. Both tapes were cut into daily fractions measuring 48 mm each and mounted using gelatine-glycerine with fuchsin as a mounting medium. Two longitudinal runs were read under the microscope (×400 magnification) on the Melinex tape coated with silicone and two longitudinal runs were read on the 3M tape. The results were multiplied by a given factor to obtain the number of pollen grains per cubic meter of air per day.

Results

Results showed a similar percentage for each taxon with respect to the total pollen count with both adhesives (Figure 1). The *Olea* pollen type was the most abundant genus captured by both adhesives, accounting for 28% of total pollen captured with silicone (10999 grains/m^3) and 38% of total pollen captured with the 3M adhesive (11591 grains/m^3). Other pollen types accounting for more than 1% of total pollen recorded with both adhesives included *Platanus*, Poaceae, *Quercus*, *Cupressus*, Moraceae, Urticaceae, *Plantago* and *Populus* (Figure 1).

The number of pollen types recorded with each adhesive was similar: 28 taxa with silicone fluid and 30 taxa with 3M tape. In 14 of these pollen types, pollen concentrations were higher with the silicone fluid; and in 17 cases, concentrations were higher with 3M tape (Table 1). The total pollen concentrations recorded with silicone fluid were higher (39693 grains/m^3) than those recorded with 3M tape (30599 grains/m^3).

Table 1. Sum concentration for the studied period with both the 3M and the silicone adhesive

Taxa	Silicone	3M
Alnus	34	22
Artemisia	6	1
Brassicaceae	121	200
Cannabis	10	23
Castanea	1	0
Casuarina	0	2
Compositae	74	137
Corylus	0	2
Cupressus	3048	1131
Cyperaceae	26	22
Chenopodiaceae	297	312
Ericaceae	9	13
Fraxinus	53	19
Helianthus	21	29
Ligustrum	75	83
Mercurialis	101	42
Moraceae	2346	2363
Myrtaceae	19	22
Olea europaea	10999	11591
Palmaceae	0	4
Pinus	136	280
Plantago	1229	1255
Platanus	9531	3376
Poaceae	3334	3250
Populus	990	698
Quercus	3456	2972
Rumex	269	305
Salix	11	5
Thypha	3	22
Ulmus	188	127
Urticaceae	2597	1498
Total	39693	30599

In general, pollen concentrations were higher with silicone for taxa flowering during winter or early spring, such as *Alnus*, *Cupressus*, *Fraxinus*, *Mercurialis*, *Platanus*, *Populus*, *Quercus*, *Salix*, *Ulmus* and Urticaceae. In contrast, for taxa flowering during late spring or early summer (when maximum temperatures of 40 °C were reached on some days) readings were higher with 3M tape. This was the case with Brassicaceae, *Cannabis*, Chenopodiaceae, Myrtaceae, *Olea*, *Pinus*, *Plantago*, *Rumex*, Compositae, *Helianthus*, *Ligustrum* and *Thypha*. In the case of the families Poaceae and Moraceae, pollen concentrations were similar with both adhesives. Although the differ-

Table 2. Correlation and Wilcoxon test between the count values obtained with both the 3M tape and the silicone fluid media

	Correlation		Wilcoxon test				
	Spearman's rho	Sig. (2-tailed)	Silicone > 3M	Silicone < 3M	Silicone = 3M	Z	Sig. (2-tailed)
Cupressaceae	0.888**	0.000	64	21	78	−6.234	0.000
Moraceae	0.910**	0.000	37	35	91	−5.529	0.597
Olea	0.956**	0.000	33	46	84	−1.002	0.316
Platanus	0.857**	0.000	42	10	111	−5.190	0.000
Poaceae	0.804**	0.000	58	49	56	−0.925	0.355
Quercus	0.910**	0.000	70	40	53	−2.227	0.026
Total	0.866**	0.000	116	47	0	−5.481	0.000

**Correlation is significant at the 0.01 level (2-tailed).
N = 163.

Table 3. Spearman's correlation test between the difference in total pollen count (silicone minus 3M total pollen concentrations) and rainfall and temperature

	Spearman's rho	Sig. (2-tailed)
Rainfall	−0.115	0.145
Temperature	−0.205**	0.009

**Correlation is significant at the 0.01 level (2-tailed).
N = 162.

ences between adhesives were small, 3M adhesive seems to become stickier at the high temperatures reached in Cordoba.

On rainy days the 3M tape seemed to be negatively affected; out of 26 days with rain, 22 presented higher pollen levels with silicone than with 3M tape. This negative influence was previously reported by Alcázar and Comtois (1999) in Canada.

Statistical results

Statistical analysis was carried out with the pollen concentrations recorded with both adhesives for the six taxa representing more than 5% of total pollen (Cupressaceae, Moraceae, *Olea*, *Platanus*, Poaceae, *Quercus*) and with the total pollen recorded. Since the data were not normally distributed, non-parametric analysis was chosen (Table 2).

Spearman's correlation revealed that the data for both adhesives were correlated since the coefficients were very high (close to 1). Correlation was significant at 0.01. Wilcoxon's test showed significant differences between the number of days with higher concentrations for each adhesive in the case of Cupressaceae, *Platanus* and *Quercus*. In these three cases, the normalized Z value and the probability showed that the difference between the two adhesives was significant for the whole distribution; higher concentrations were observed over more days with silicone than with 3M tape. For the other taxa studied, no significant differences were detected between the number of days with higher pollen concentrations using either adhesive.

Spearman's correlation test was performed between the difference in total pollen count (silicone minus 3M total pollen concentrations) and meteorological factors (temperature and rain). The results (Table 3) showed that pollen count differences and temperature were significantly correlated with a negative coefficient, which revealed that higher temperatures caused higher pollen concentrations with 3M tape whereas lower temperatures favoured silicone fluid with respect to 3M tape. In the case of rain, no significant correlation was observed, perhaps because there were few rainy days as rain was concentrated on very few days.

Conclusions

Both adhesives – silicone fluid and 3M – showed a huge degree of similarity in terms of their capacity to capture airborne pollen grains. The number of pollen types recorded was slightly higher with 3M tape than with silicone fluid and there were more pollen types with higher concentrations with 3M tape than with silicone. Nevertheless, the total pollen count recorded during the study period was higher with silicone fluid because when pollen concentrations were higher with 3M tape the differences were small. In contrast,

for pollen types with higher concentrations with silicone fluid as adhesive, the differences were highly significant with respect to 3M tape. The 3M adhesive would be a good solution for standardizing capture media with Hirst samplers, since the variation caused by manual application of the adhesive by different operators would be eliminated. Nevertheless, although slight differences were observed between the results obtained with both adhesives, sometimes being higher with silicone and sometimes with 3M tape, the pollen counts obtained with 3M tape were underestimated for some important allergenic pollen types such as Cupressaceae and Platanus, which showed very low concentrations when 3M tape was used with respect to silicone. Silicone fluid does not vary with temperature; it remains inalterable between −20°C and +150 °C (Galán and Domínguez-Vilches, 1997). However, the efficiency of 3M adhesive seems to vary with the temperature. The adhesive of 3M tape hardens during winter, thus losing its efficiency, and becomes stickier during summer, when it is more efficient. Although zero or below zero temperatures were reached in the study area on isolated days, the capture efficiency of 3M adhesive should be tested on many days with temperatures below zero in order to prove its efficiency even under snow and frost conditions. Although most rainy days presented higher pollen concentrations with silicone fluid as the capture media, the negative influence of rain on 3M tape was not statistically demonstrated. Nevertheless, rain could be a factor to be considered in the use of 3M in places with more frequent rainy days.

References

Alcázar P. and Comtois P.: 1999, A new adhesive for airborne pollen sampling. *Aerobiologia* **15**, 105–108.

Comtois P. and Mandrioli P.: 1997, Pollen capture media: A comparative study. *Aerobiologia* **13**, 149–154.

Galán C. and Domínguez-Vilches E.: 1997, The capture media in aerobiological sampling. *Aerobiologia* **13**, 155–160.

Razmovski V., Timothy O., Hjelmroos M., Marks G. and Tovey E.: 1998, Adhesive tapes as capturing surfaces in Burkard sampling. *Grana* **37**, 305–310.

Solomon W.R., Burge H.A. and Boise J.R.: 1980, Performance of adhesives for rotating-arm impactors. *J Allergy Clin Immunol* **65**, 467–470.