

## A new adhesive for airborne pollen sampling

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### Abstract

There is a spreading interest to establish networks of information exchange on aerobiological data in order to carry out comparative studies of the biological air content of different regions. For this kind of study, it is of primary importance that the methods used are being standardized. Since most national networks are now made of comparable Hirst-type samplers, the second most important factor to consider will be the efficiency of the adhesive used on the Melinex tape. In this study, we report conclusive results using a double-side self adhesive acrylic tape (Scotch 3M 9425). Our results show higher capture efficiency (+20%) for the 3M tape as compared to the glycerine/gelatine coating traditionally used in Montréal for the capture of airborne pollen on the Melinex tape of Hirst samplers.

### 1. Introduction

Almost all national aerobiological networks used different adhesive on the Melinex tape of Hirst-type volumetric samplers. These are either proposed by the different manufacturers of the samplers or are the one traditionally used for airborne pollen sampling before the advent of volumetric samplers. However, very few studies have been done to corroborate the similarity of efficiency between different adhesive substances or even to measure their efficiency. Solomon et al. (1980) have studied the collection efficiency of Ambrosia pollen capture using silicone grease, white petrolatum and lubriseal and have encountered only very small differences. Both Comtois and Mandrioli (1997) and Galan and Dominguez-Vilchez (1997) have concluded to non-significant differences between different adhesives.

We also have to consider the source of variation due to the application of the capture media on the Melinex tape. Here, again, there are individual preferences for the methodology used. Moreover, even for

the same operator it can be difficult to produce replicable coat depth and uniformity. This was put forward by Comtois and Gagnon (1992) to explain the large variation found between two rods of the same Rotorod samplers. These authors suggested that this factor must be controlled before taking into account any efficiency comparison. The adhesive used should be, and could be, something as standard as the sampler.

In this paper, we present the results of an adhesive that eliminates all manipulations previously needed to prepare a coated Melinex tape. It is a commercially available tape made by 3M Scotch Brand (#9425). It is a Hi-tack/medium-tack acrylic adhesive with a high resistance to solvents. This tape was recommended to us by Larry Syzdek of the Biological Survey of the New York State Museum, who has used it successfully for spores capture (pers. comm.). This tape complies with the characteristics put forward by Kapyła (1989) in order to consider a substance as a good adhesive for airborne particles.

## 2. Materials and methods

The experiment was done using a Burkard 7-day spore trap located on the roof (15 m) of our department on the campus of the University of Montréal. We sampled for a whole month, from August 30th to September 27th, 1995. Exactly half of the weekly drum was covered by a Melinex tape coated with a gelatine/glycerine medium, while the other half was covered with the 3M tape. The drum position of the two surfaces was randomized. After a week of sampling, the two tapes were cut in daily fractions of 48 mm each. The two-halves tape corresponding to the same sampled day were put on the same 75 mm slide and covered first with a gelatine and basic fuchsin stain and then with a 50 mm cover slip.

Two longitudinal lines were read on the gelatinized Melinex tape and two longitudinal lines were read on the 3M tape. Therefore, for each tape, two lines of 0.46 mm were read for the estimation of the total pollen count on 14 mm. The sampler was drawing 10 litres of air a minute, so all raw counts were multiply by 1.056 to express results as numbers of pollen grains per cubic meter of air per day. All pollen were identified and counted. However, our study was focused on *Ambrosia* pollen, the dominant pollen taxa in the studied period and area (Comtois and Gagnon, 1988). In order to be able to use parametric statistical tests, the pollen count data were first normalized by using the neperian logarithm of the pollen concentration plus one ( $\ln + 1$ ).

## 3. Results

In Table 1, it can be seen that both the summation and the mean number of pollen grains are higher when the 3M tape is used for almost all the taxa encountered in our samples. This adhesive has, therefore, a high capture capability for airborne pollen grains. We have also represented graphically the daily concentrations obtained with gelatine/glycerine and the 3M tape for the two most abundant taxa (*Poaceae* and *Ambrosia*) (Figures 1 and 2), since the other taxa contribute minimal and sporadic concentrations. It can be seen in these graphs that the 3M curve is almost always on top of the gelatine/glycerine one. However, for these infrequent cases where the gelatine/glycerine medium supersedes the 3M tape, such as on the 7th of September, these differences can be considerable. Indeed, on that day, the concentration obtained with

Table 1. Sum and mean concentration for the studied period for both the 3M tape and the gelatine/glycerine media.

| Taxa           | Total: 3M | Gelatine | Mean: 3M | Gelatine |
|----------------|-----------|----------|----------|----------|
| Ambrosia       | 1117      | 776      | 38.52    | 26.76    |
| Poaceae        | 108       | 96       | 3.72     | 3.21     |
| Urticaceae     | 6         | 1        | 0.21     | 0.03     |
| Chenopodiaceae | 10        | 7        | 0.34     | 0.24     |
| Plantago       | 2         | 0        | 0.07     | 0.00     |
| Pinaceae       | 1         | 1        | 0.03     | 0.03     |
| Artemisia      | 4         | 6        | 0.14     | 0.21     |

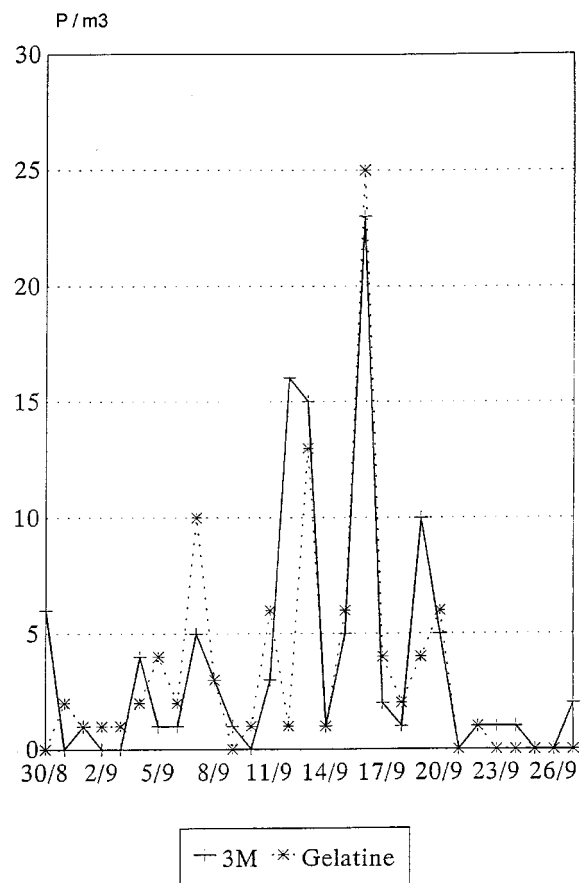


Figure 1. A comparison between results obtained for *Poaceae* using the 3M tape or the gelatine/glycerine media.

gelatine/glycerine for both *Poaceae* and *Ambrosia* exceeded the 3M tape by 20 to 50%. An observation of the meteorological conditions on that day reveals that rainfall was abundant. It may indicate that the 3M tape is negatively affected by rain.

The calculation of the neperian logarithms of the pollen concentrations has given normally distributed frequencies, so that parametric tests can be used.

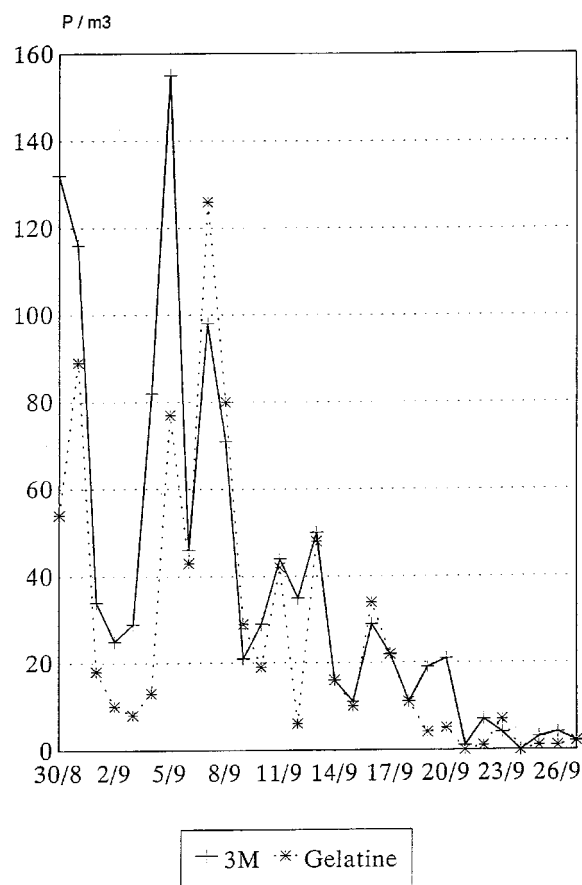


Figure 2. A comparison between results obtained for Ambrosia using the 3M tape or the gelatine/glycerine media.

Table 2. Correlation coefficients and Student "t" test for the count values obtained with both the 3M tape and the gelatine/glycerine media.

| Mean gel. | Mean 3M | Diff. mean | Corr  | Prob  | T     | Prob  |
|-----------|---------|------------|-------|-------|-------|-------|
| 2.5906    | 3.0612  | -0.4706    | 0.888 | 0.000 | -4.00 | 0.000 |

The correlation analysis (Table 2) shows that the concentrations of Ambrosia pollen obtained with both capture media are linked ( $R^2$  of 0.79;  $p < 0.0001$ ). The 3M concentrations can be forecasted from the gelatine/glycerine ones using the formula:

$$\ln Y = 0.377 + 0.938 \ln X,$$

both regression coefficients being significant ( $p$ : 0.02 and  $<0.0001$  respectively for the Y intercept(a) and the slope(b)). The correlation is positive, so that when a high concentration is reached with

Table 3. Wilcoxon test between the count values obtained with both the 3M tape and the gelatine/glycerine media.

| 3M > gel. | Gel. > 3M | Z       | 2-tail prob. | Total pairs |
|-----------|-----------|---------|--------------|-------------|
| 19        | 5         | 2.65361 | 0.00796355   | 29          |

gelatine/glycerine, the counts also increase on the 3M tape. The slope (coefficient b) is very near unity, which also means that the progression on the regression line is almost on a one-to-one basis. The Y intercept being significantly different than one, and positive, also means that the 3M tape is more efficient than the gelatine/glycerine media. Finally, the determination coefficient ( $R^2$ ) indicates that almost 80% of the variation of the gelatine/glycerine count can be "explained", i.e. forecasted by the 3M counts.

A similar conclusion can be reached with the student "t" test (Table 2). Indeed, a strong correlation could be obtained by largely different results that have a large covariance. In our case, the paired "t" value of -4.00 associated to a probability smaller than 0.0001 indicates that the differences between the two media are significant for Ambrosia pollen, in full flowering at the time of sampling, and that these differences are in favour of the 3M tape.

The Student "t" test compares only the mean value of the distribution of the difference between the media. A non-parametric test (the Wilcoxon paired test) was also done to compare the whole distribution of both media (Table 3). The normalized (Z) value of the test (2.653) associated to a 0.008 probability shows that indeed the difference is significant for the whole distribution. For the other taxa observed in this study, no significant difference was found. However, this could be the result of many null values in the tested data set.

#### 4. Conclusions

The 3M adhesive tape could be a good solution to standardize the capture medium used in pollen concentration estimation studies. With the utilization of the 3M tape, we can eliminate the variation hidden in the use of different capture media and in the work of different operators. Indeed, both these factors are encountered in the so-called "adhesivity" of the media.

Moreover, we have shown that, at least for Ambrosia pollen, the efficiency of capture was higher

using the 3M tape. It remains to be seen, however, how the 3M tape compares to other media, and if it can be used in other bioclimatic zones, especially those with high summer temperatures. The shelf life of fully adhesive 3M tape and its optimal storage conditions should also be investigated. More studies are therefore needed before we can make general recommendations. However, even taking into account these restrictions, the 3M tape seems to be a very promising capture media.

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