Preliminary Survey of Airborne Pollen and Mold Spores in Central Minnesota (USA)

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Introduction:

The purpose of this study was to document the airborne pollen and mold spores present in central Minnesota (USA) and to provide a baseline for future studies. Previous studies in the Rochester (MN) area show that pollen species in the air vary during the course of the season. Trees appear early followed by grasses and then forbs such as ragweed (Decco *et al*, 1998). Our expectation was that the pollen flora in central Minnesota would be similar. To our knowledge, no one has reported airborne pollen species or their temporal distribution in central Minnesota.

We used a Multidata Model 40 Rotorod Sampler in our studies. This instrument, which is an impact-type sampler, catches pollen on each of two greased rods. Typically, one rod is stained and analyzed while the other rod serves as a backup. As a prelude to our study we wanted to confirm that a single rod provides a valid count. In addition, we wanted to confirm the counting accuracy of our various counters.

Objectives:

- Document the pollen and mold flora of central Minnesota
- Identify the temporal patterns of pollen and mold spore presence in the air
- Confirm that both rods from the Rotorod Model 40 yield equivalent pollen counts
- Confirm that different counters obtain equivalent results
- Provide a baseline for the occurrence of pollen species in the air in central Minnesota

Methods

We used a Rotorod Sampler (Model 40) to make our counts. Rods were collected nearly daily, stained with Calberla's solution and then analyzed using an Olympus compound light microscope fitted with a standard counting reticule. The sample duration and duty cycle were recorded and the counts were converted to grains per m^3. Typically both sample rods were counted and the mean from the two rods was reported. A paired t-test was performed to determine if there was a statistical difference between the two counts. In addition, on 12 occasions each rod was counted by two individuals and a paired t-test was performed to determine if there were differences in the accuracy of the counters.

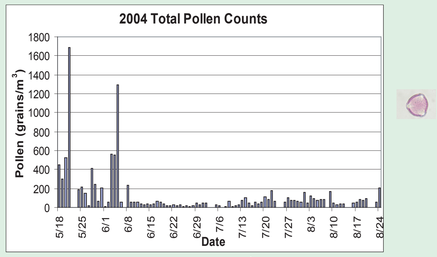


Figure 3: Summary of 2004 daily pollen counts (grains/m^3).

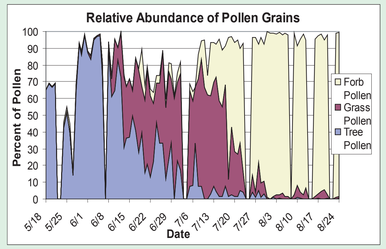


Figure 6: Relative abundance of pollen types in 2004

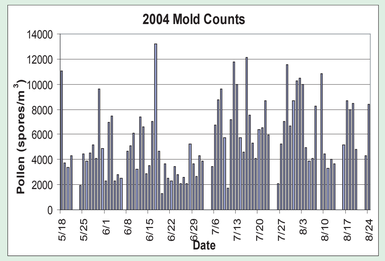


Figure 7: Summary of 2004 daily spore counts (spores/m^3).

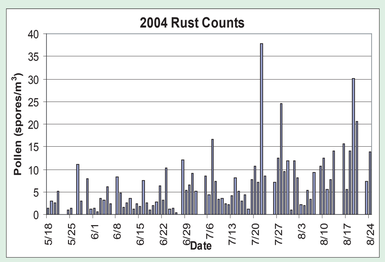
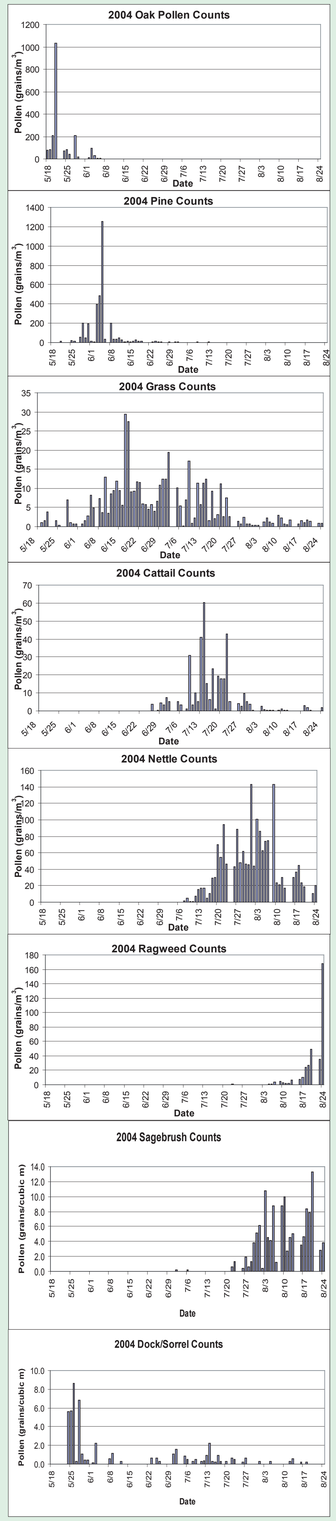


Figure 8: Summary of 2004 daily rust counts (spore/m^3).



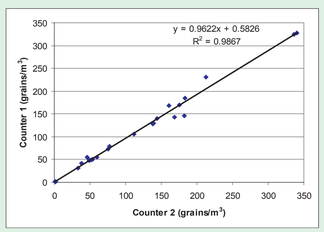


Figure 1: Comparison of pollen grains counted on a sample rod by two different pollen counters.

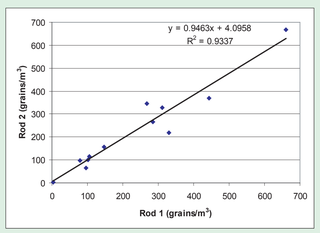


Figure 2: Comparison of pollen counts between different sample rods.

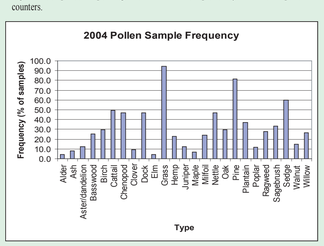


Figure 4. Percent of sample days in which a particular pollen type was encountered in a sample.

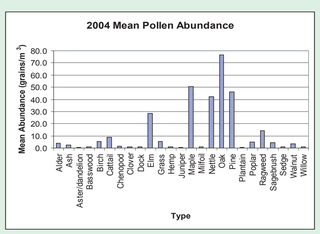


Figure 5. Mean concentration of pollen types (grains/m^3)

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Results

- 86 samples were collected with a Rotorod sampler from mid-May until late October (2004). Raw data are reported at http://www.csbsju.edu/pollen.
- No statistically significant difference ($p = 0.093$) was observed between the two individuals who counted the same sample collector rod (*Figure 1*).
- No statistically significant difference ($p = 0.549$) in pollen counts were observed between the two sample rods (*Figure 2*).
- The highest concentrations of airborne pollen were detected in late May/early June (*Figure 3*).
- The most frequently observed pollen types were grass > pine > sedge > cattail > chenopod, dock, nettle (*Figure 4*).
- The pollen types with the highest concentration were oak > maple > pine > nettle > elm > ragweed. The mean concentration of the remaining species was less than 10 grains/m^3 (*Figure 5*)
- Tree pollens appear first followed by grass pollens and finally forb pollens (*Figure 6*).
- Mold spores were observed in every sample. Spore concentration varied extensively (1311–13220 per m^3). On average we observed 5649 spores/m^3 (*Figure 7*).
- Rust spore abundance was also variable (0.3 – 37.7/m^3). Rusts were observed in nearly all samples (96.3%) though in low abundance (mean = 6.8/m^3; *Figure 8*).
- Tree pollen was the predominant pollen-type observed in the early spring (*Figure 6*). The mean daily tree pollen concentration was 87.4 grains/m^3. There was an early peak of oak/maple pollen followed by a peak of pine in early June (*Figures 9 & 10*)
- Grass pollens (including cattail and sedges) were detected the entire season (mean = 11.0 grains/m^3). Cattails peaked in mid-July while sedges were most abundant in late May/early June (*Figures 11 & 12*).
- Forb pollens (see *Figures 13-15*) appeared in high frequency in mid-July and were the dominant grains until the end of the counting period. The mean daily concentration was 27.1 grains/m^3.
- The survey by Decco *et al* (1998) observed pollens from apple, mulberry and golden rod that were either absent or in low frequency (goldenrod) in our samples
- Ragweed pollen was less abundant and present later than in the survey by Decco *et al* (1998) (*Figure 14*).

Discussion

This study employed a Rotorod sampler to make pollen and mold spore counts during the 2004 growing season in central Minnesota (USA). Our studies confirmed that it was only necessary to count one of the two sample rods obtained from the Rotorod since they yielded statistically identical results. In addition, our preliminary work showed that our pollen counters obtained statistically identical results when counting the same sample rod. This demonstrates that the Rotorod sample method is reproducible and that our program to train counters was successful. This insures that data reported by future counters will not be biased and will be comparable to that obtained in the current study.

To our knowledge, this is the first report of a pollen distribution spectrum for central Minnesota. The pattern and frequency of pollens that we observed are comparable to studies done in the Minneapolis/St. Paul (Rosendahl *et al*, 1940; Frenz & Murray, 1997) and Rochester (Decco *et al*; 1998) areas. The temporal patterns of airborne pollen (trees > grass > herb) follows precisely those previously reported.

With a few exceptions, the concentration of pollens that we observed was also similar to previous studies (Decco *et al*; 1998). For example, we observed markedly higher concentrations of pine and oak pollen compared to the Rochester area. This is partly due to the location of our sampler which is about 50 meters west of a wooded area dominated by Scotch pine (*Pinus sylvestris*), white oak (*Quercus alba*), northern red oak (*Q. rubra*) and sugar maple (*Acer saccharum*).