CASE REPORT

Mark Horrocks,[1] *Ph.D. and Kevan A. J. Walsh,*[2] *M.Sc.*

Pollen on Grass Clippings: Putting the Suspect at the Scene of the Crime

REFERENCE: Horrocks M, Walsh KAJ. Pollen on grass clippings: putting the suspect at the scene of the crime. J Forensic Sci 2001;46(4):947–949.

ABSTRACT: In a case of alleged sexual assault, the pollen content of samples of grass clippings and soil from the suspect's clothing and shoes was compared to that of a sample of grass clippings from the alleged crime scene (a grassy area) to determine whether or not the suspect had been at the scene. The clothing and shoe samples showed a very strong correlation with each other and with the sample from the alleged crime scene in the combination of the different types of pollen present, very strongly supporting the contention that the suspect had been at the scene.

KEYWORDS: forensic science, pollen, palynology, grass clippings, soil, clothing

Forensic palynology is the science of deriving evidence for court purposes from pollen and spores. Various methods and examples have been described by Mildenhall (1–3), Bryant et al. (4), Stanley (5,6), Bruce and Dettman (7), Eyring (8), Horrocks et al. (9–11), Bryant and Mildenhall (12), and Horrocks and Walsh (13–15).

Many plants release pollen grains (or spores) at certain times of the year. Only a small proportion of these microscopic reproductive parts fulfill their biological function—most eventually settle on the ground. The outer wall of pollen grains is composed of sporopollenin, one of the most durable biological substances (16). Consequently, pollen is highly resistant to decay and may persist for years, centuries, or millenia after being released, depending on preservation conditions. Pollen that has settled on the ground may be collected from soil surfaces or from objects on the ground, including other plants, and analyzed.

Wind-pollinated plants generally produce abundant pollen which may be dispersed long distances (up to hundreds of kilometres), whereas animal (mainly insect)-pollinated plants produce much smaller amounts of pollen, most of which is deposited on the ground within a few meters of the parent plant. The difference between species' pollen production and dispersal results in pollen representations which may change considerably over just a few meters. Using pollen analysis, Horrocks and Walsh (14) were able to differentiate a crime scene and alibi scene only 7 meters apart.

In New Zealand, samples taken from soil surfaces or from objects on the ground may contain dozens of different pollen types. Some of these (e.g., pine and grass pollen) are wind dispersed and therefore commonly found in samples regardless of whether or not the parent plants are, or have been, locally present. Insect-dispersed pollen types, however, being locally dispersed, are "uncommon" pollen types, tending to be found only in samples taken from within a few meters of parent plants. Another form of uncommon pollen type may be from plants that, although having well dispersed pollen, occur in low abundance in that particular area, region, or country. Spores from nonpolleniferous plants, such as ferns, also vary in production and dispersal distance.

Many crime scenes (e.g., the break and entry point of a building or a rape scene under a tree) may be defined as "localized areas" since they are generally restricted to only a few square meters (10). Localized areas will have a particular combination of plant species comprising the local and surrounding vegetation (e.g., forest, pasture, lawn) that produces a particular pollen combination or "assemblage" in their soil and on local objects. Since pollen assemblages from different localized areas typically show a wide variance, the finding of a correspondence of pollen assemblages for two samples may therefore very strongly suggest that the samples are from the same source (13,15).

Alleged Crime

In this case, it was alleged that the male defendant had attacked the complainant on a "grassy area, lying on top of her and indecently assaulting her." The defendant denied this allegation, claiming not to have been at the grassy area. The defendant had grass clippings and soil on his jeans and shoes.

In the absence of more obvious biological or physical evidence linking the suspect to the grassy area, it was necessary to consider the evidence of the grass clippings and soil on the suspect's jeans and shoes. It was decided that pollen analysis and comparison of the grass clipping and soil samples would be the best means to assist in determining whether or not the suspect had been at the scene. A sample of grass clippings mixed with soil had been taken from the soles of his shoes, and a sample of soil had been taken from the knee and lower leg area of his jeans. A sample of grass clippings had also been taken from the grassy area (the alleged crime scene). These samples were analyzed for pollen to determine whether or

[1] Centre for Archaeological Research, University of Auckland, Private Bag 92-019, Auckland, New Zealand.

[2] Institute of Environmental Science & Research Ltd, Mt Albert Science Centre, Private Bag 92-021, Auckland, New Zealand.

Received 8 Feb. 2000; and in revised form 6 June 2000; accepted 1 August 2000.

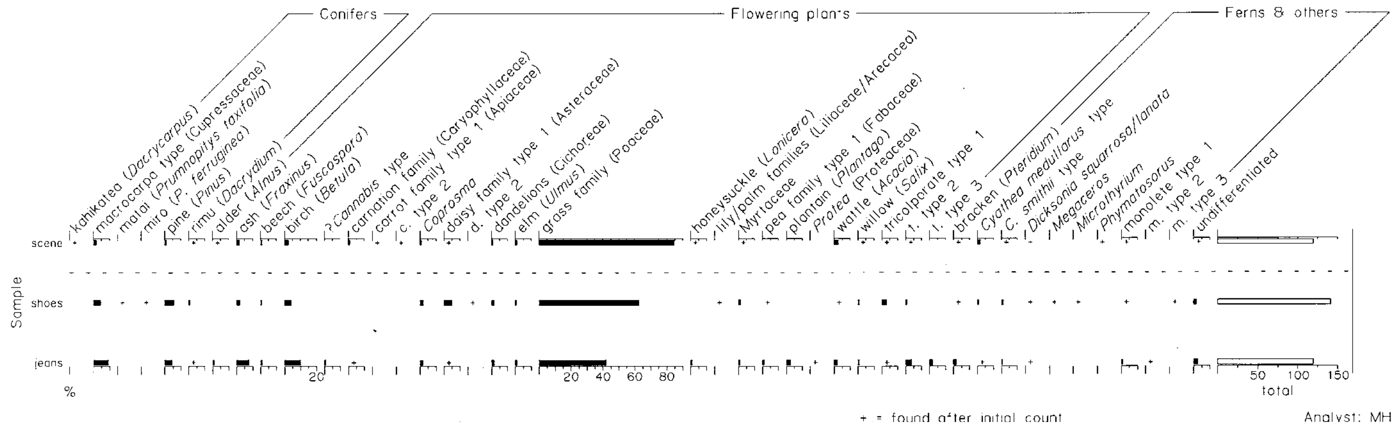

FIG. 1—*Pollen analysis of soil samples from the alleged crime scene and from the suspect.*

not any of the grass clippings and soil on the suspect's jeans and shoes had come from the grassy area.

Methods

Four separate areas of soil on the jeans (both knees, inner lower right leg, and outer lower left leg) were cut off and combined as one sample. All samples were prepared for pollen analysis by the standard KOH (deflocculation), acetylation (cellulose and organic matter removal), and hydrofluoric acid (silicate removal) method (16). Bleaching (further organic matter removal) with sodium chlorate and phosphoric acid was also carried out. All procedures were used on all samples. Deflocculation involved heating samples in 10% KOH for approximately 20 min. The cut off pieces of jeans cloth were removed and discarded from the jeans sample after this step. A binocular microscope at 400 to 1000× magnification was used for pollen identification and counting. Some of each sample was retained for possible further analysis, e.g., pollen analysis by other parties, or for analysis of other soil components such as minerals.

In the pollen diagram, the pollen types were assigned to the following three groups: 1) conifers, 2) flowering plants, and 3) ferns and others. The first two groups are comprised of pollen-producing plants while the third is comprised of nonpolleniferous plants that produce spores. Spores are included in the term "pollen types." The total number of pollen and spores counted for each sample, from which the percentages for each pollen type are calculated, is shown on the right of the diagram. Slides were scanned after the initial count and pollen types not found during the count were noted. The software packages TILIA and TILIAGRAPH (E. Grimm, Illinois State Museum, Springfield, IL) were used to construct the pollen diagram.

Results

Pollen analysis results for samples are shown in Fig. 1. The sample of grass clippings from the grassy area was, not surprisingly, dominated by grass pollen (85%), with all other pollen types each comprising less than 5%. There was a very strong correlation in the combination of the different types of pollen present between each of the samples from the suspect and with the sample from the grassy area. The jeans and shoe samples were also dominated by grasses (42% and 62%, respectively), with all other pollen types each comprising less than 10%. Significantly, the samples from the suspect contained 12 of the same uncommon pollen types as the sample from the alleged crime scene. Of these 12 uncommon pollen types, five (alder, birch, carnation family, *Coprosma,* and *Dicksonia squarrosa/lanata*) were considered significant, and the remaining seven (ash, elm, honeysuckle, wattle, willow, and tricolporate types 1 and 2) were considered highly significant (i.e., are more uncommon).

Discussion and Conclusions

The presence of grass clippings on the ground at the grassy area obviously indicates that the grass had been mown (without a catcher) a short time before the alleged crime was committed. The presence of grass clippings on the suspect's clothing and shoes is thus in itself significant, suggesting that the suspect had been on a mown area. As for the pollen evidence, the very strong correlation in the combination of the different types of pollen present between each of the samples from the suspect and with the sample from the grassy area very strongly supports the proposition that the three samples are from the same localized area. Of particular significance is the presence in the samples from the suspect of twelve of the same uncommon pollen types as the sample from the alleged crime scene. These pollen types are from plants that either have only locally dispersed pollen (a few meters), or occur in generally low abundance in New Zealand.

Considering the potential for variation between pollen samples given the large number of different types of pollen usually present, we would not have expected to find such a very strong correlation of pollen types in the samples from the suspect and the sample from the grassy area, if the samples had come from different areas. It could be argued that this very strong correlation was coincidental and that the grass clippings and soil on the jeans and shoes came from another area elsewhere with similar vegetation to that of the grassy area. However, Horrocks et al. (10) showed that localized areas of similar vegetation type (e.g., open, grassy areas), even within the same geographic region, have significantly different pollen assemblages. Therefore, although the assemblage could not be considered to be unique to that localized area, the pollen evidence in this case very strongly supports the contention (13,15) that the grass clippings and soil on the assault suspect's clothing came from the alleged crime scene.

References

1. Mildenhall DC. Forensic palynology. Geological Society of New Zealand Newsletter 1982;58:25.
2. Mildenhall DC. Deer velvet and palynology: an example of the use of forensic palynology in New Zealand. Tuatara 1988;30:1–11.

3. Mildenhall DC. Forensic palynology in New Zealand. Review of Palaeobotany and Palynology 1990;64:227–34.
4. Bryant VM Jr, Jones JG, Mildenhall DC. Forensic palynology in the United States of America. Palynology 1990;14:193–208.
5. Stanley EA. Application of palynology to establish the provenance and travel history of illicit drugs. Microscope 1992;40:149–52.
6. Stanley EA. Forensic palynology. Federal Bureau of Investigation International Symposium on Trace Evidence. Washington, DC: US Government Printing Office, 1993.
7. Bruce RG, Dettman ME. Palynological analysis of Australian surface soils and their potential in forensic science. Forensic Sci Int 1996;81:77–94.
8. Eyring MB. Soil pollen analysis from a forensic point of view. Microscope 1997;44:81–97.
9. Horrocks M, Bedford KR, Morgan-Smith RK. The filtering effects of various household fabrics on the pollen content of hash oil (cannabis extract). J Forensic Sci 1997;42:256–9.
10. Horrocks M, Coulson SA, Walsh KAJ. Forensic palynology: variation in the pollen content of soil surface samples. J Forensic Sci 1998;43: 320–3.
11. Horrocks M, Coulson SA, Walsh KAJ. Forensic palynology: variation in the pollen content of soil on shoes and in shoeprints in soil. J Forensic Sci 1999;44:119–22.
12. Bryant VM Jr, Mildenhall DC. Forensic palynology: a new way to catch crooks. In: Bryant Jr. VM, Wren JW editors. New developments in palynomorph sampling, extraction, and analysis. American Association of Stratigraphic Palynologists Foundation, Contribution Series Number 33, 1998;145–55.
13. Horrocks M, Walsh KAJ. Forensic palynology: assessing the value of the evidence. Rev Palaeobot Palynol, Special Edition: New Frontiers in Palynology IX IPC. 1998;103:69–74.
14. Horrocks M, Walsh KAJ. Fine resolution of pollen patterns in limited space: differentiating a crime scene and alibi scene seven metres apart. J Forensic Sci 1999;44:417–20.
15. Horrocks M, Walsh KAJ. Forensic palynology: assessing the weight of the evidence. Proceedings of the 9th International Palynological Congress, Houston TX, 23–28 June, 1996, in press.
16. Faegri K, Iversen J. Textbook of pollen analysis. 4th Rev. Ed. Chichester: John Wiley & Sons, 1989.

Additional information and reprint requests:
Mark Horrocks, Ph.D.
Centre for Archaeological Research
University of Auckland
Private Bag 92-019
Auckland, New Zealand