

# THE USE OF ANIMAL-DISPERSED SEEDS AND FRUITS IN FORENSIC BOTANY

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## ABSTRACT

A specific case of the forensic use of animal-dispersed propagules is presented, and it is suggested that this type of evidence deserves wider utilization by the law enforcement community. Animal dispersed seeds and fruits are ubiquitous, often cling tenaciously to clothes or other materials worn or used by suspects, and are small and frequently go unnoticed. Furthermore, their identification is relatively inexpensive and technically straightforward, and their presentation as evidence is visually and intuitively obvious, making it ideal for the courtroom. It is also suggested that forensic botany is an excellent topic to use as a case study in college botany or biology classes because of its inherent interest and integrative nature. In order to facilitate such usage, a brief review of some aspects of forensic botany is presented including references to pertinent literature.

## RESUMEN

Se presenta un caso específico de propágulos diseminados por animales en uso forense, y se sugiere que este tipo de evidencia puede tener mayor utilización en varios aspectos legales. Las semillas y frutos dispersados por animales están por todas partes, a menudo se enganchan tenazmente a las ropas u otros materiales llevados o usados por sospechosos, y por ser pequeños pasan frecuentemente inadvertidos. además, su identificación es relativamente barata y técnicamente sencilla, y su presentación como prueba es obvia visual e intuitivamente, convirtiéndose en ideal para los juicios. Se sugiere también que la botánica forense es un tema excelente para ser usado como caso práctico en las clases de biología por su interés inherente y naturaleza integrativa. Para facilitar ese uso se hace una breve revisión de algunos aspectos de la botánica forense incluyendo las referencias bibliográficas pertinentes.

The use of plants in justice and legal systems is thousands of years old, probably beginning in such ways as trials by ordeal (Talalay et al. 1991; Mabberley 1997). In these cases, suspects were forced to eat poisonous plants and guilt or innocence was determined by survival. Presumably, this was based on a psychological effect of guilt on the vomiting reflex—supposedly, innocent individuals would expel the poisonous material, while the

guilty would retain the poison and thus die; the efficacy of such a technique is obviously questionable. The use of plant material as evidence has also appeared in fictional works, such as the series of books by Ellis Peters about the medieval Welsh monk/herbalist/sleuth, Brother Cadfael (Whiteman 1995) and the works by H.C. Bailey about the detective, Reginald Fortune (Bailey 1936, 1943).

The modern use of plants as evidence in a court case dates to the famous 1930s Lindbergh kidnapping case in which the son of Charles and Anne Morrow Lindbergh was kidnapped and murdered. Largely through evidence provided by botanist Arthur Koehler, Bruno Hauptmann was convicted of the crime in 1935. Koehler demonstrated that the ladder used in the kidnapping was built in part from wood taken from the attic of Hauptmann's residence (Tippo & Stern 1977; Baden 1983; Haag 1983; Lane et al. 1990; Graham 1997). Koehler's evidence included identification of the wood based on anatomical characteristics, matching of annual growth rings, and unique markings made on the wood by tools including a lumber yard planer and a hand plane. Detailed accounts of the botanical evidence including photographs and graphics can be found in Tippo and Stern (1977), Haag (1983), and Graham (1997). Graham (1997) gave an extensive list of references. This was a landmark case, not only because it led to the formation of federal kidnapping laws (Bock & Norris 1997), but also because the obvious value of the evidence provided by Koehler set the stage for future forensic uses of botanical information.

Since that time, there have been numerous other examples of forensic botany (and other biological disciplines such as entomology—e.g., Rozen and Eickwort 1997). The use of plant fragments, pollen grains or fungal spores, plant trichomes (hairs), anatomical evidence from indigestible cell wall material from the stomach contents of crime victims, molecular evidence utilizing DNA, and ecological evidence useful in locating hidden graves, crime sites, or dating when a crime occurred are just a few examples (Bock et al. 1988; Lane et al. 1990; Mestel 1993; Yoon 1993; Blaney 1995; Bates et al. 1997; Bock & Norris 1997; Graham 1997; Lewis 1997; Lindell 1997). The following specific cases show some of the diversity in the field of botanical forensics. Lane et al. (1990) discussed a rape case in which leaves and bark fragments were found in the pants cuffs of a suspect. The material had gotten into his cuffs while he was climbing a tree to gain access to a window of the victim's house. His claim, that the victim had let him in through a door, did not match the botanical evidence. Another example used by Lane et al. (1990) involved a child abuse case. The parents claimed that the child had been fed fruit cocktail just prior to dying. However, their story was contradicted when his stomach contents showed no evidence of the anatomically characteristic materials expected from such a meal (e.g.,

stone cells from pears or needle-shaped crystals from pineapples). In the case of a 1989 plane crash near Ruidoso, New Mexico, it was alleged that an engine design flaw had allowed particulate matter (pollen) to build up in the engine and cause the crash. However, it was shown that since the pollen was in fresh condition and had normal cytoplasm and cell walls as seen by electron microscopy, it could not have been exposed to the high temperatures present during engine operation or in the post-crash fire that distorted even aluminum. Further, the pollen was that of insect-pollinated plants found near the storage site of the plane wreckage; such pollen grains are unlikely to be found in any quantity in the atmosphere. Based on the evidence from forensic palynology, it was concluded that the pollen had gotten into the wreckage post-crash during several months of storage and therefore had nothing to do with the accident (Blaney 1995; Brunk 1997; Graham 1997; Lewis 1997). A final example is the use of molecular evidence linking a murder suspect to a palo verde tree (*Parkinsonia aculeata* L., Fabaceae) at an Arizona crime site where he allegedly dumped the body of a victim. Plant geneticist Tim Helentjaris of the University of Arizona demonstrated that two seed pods found in the suspect's truck came from a specific palo verde tree scraped by the suspect's truck at the crime scene. This example is important because it was the first in which plant DNA was used in a criminal case (Mestel 1993; Yoon 1993). Overviews of forensic botany were provided by Lane et al. (1990) in the general science literature and by Bock and Norris (1997) in the forensic science literature.

Our interest in this topic has developed over the course of a number of years during which as plant taxonomists we have been called upon numerous times by poison centers, hospitals, and law enforcement agencies to identify plants or their fragments. We agree with Bock and Norris (1997) that forensic botany is a resource underutilized by the law enforcement community. Further, we believe that forensic botany can be very effectively used in botany or biology courses to show the importance, applicability, and integrative nature of botany. Because forensic botany cuts across all botanical disciplines and because a given case may require many research approaches and techniques, it is a discipline that can stress the integrative nature of botany and science as a whole. Additionally, it is an excellent topic to use in emphasizing problem solving and critical thinking skills. The purpose of the present article is thus two-fold. First, based on our successful use of such information in college teaching, we want to provide in an easily accessible botanical journal a brief review of forensic botany and appropriate references in order to encourage further such usage. Second, we present a specific case of the forensic use of animal-dispersed propagules and suggest that this type of evidence has the potential to be more widely used in criminal investigations.

On July 12, 1995, a sleeping two year old girl was pulled from the first floor window of an apartment in Fort Worth, Texas. The child was sexually molested, but fortunately was found alive about three hours later in a weedy area several hundred meters from where she was abducted. Assorted evidence was used in the case including fingerprints and DNA from semen. However, the easily understandable botanical evidence was an important factor in convincing the jury of the suspect's guilt. Because the Botanical Research Institute of Texas (BRIT) is a well known source of botanical information in the local community, we were contacted by the district attorney's office to identify tiny plant fragments taken from the shoelaces of the suspect. In addition, we were provided with a bag of assorted plant material that had been collected from the crime scene where the child was left (Fig. 1). Upon opening the evidence envelope, we immediately recognized the ca. 4 mm long plant fragments as single-seeded mericarps from a member of the Apiaceae (carrot family). Using a dissecting scope and authenticated specimens in the Botanical Research Institute of Texas herbarium, these were identified as mericarps of *Torilis arvensis* (Huds.) Link, an introduced species commonly known as hedge parsley. The bag of material from the crime scene was then examined and a mature, fruit-bearing plant of hedge parsley was found. Under a dissecting scope, the small mericarps of this species (Fig. 2) are very distinctive. They are densely covered with bristles tipped with microscopic barbs that enhance their attachment to fur or clothing. They also have several very characteristic lines of closely appressed hairs between the bristles. Large photographs of mericarps from both the suspect's shoelaces and the crime scene (Fig. 3) were presented in court by one of us (BLL). Like fingerprints, this was distinctive visual evidence, more easily understood than the scientifically sound but conceptually complex evidence provided by molecular techniques such as DNA analysis. Because the suspect could have possibly picked up the mericarps from some other location, the botanical evidence alone would not have been sufficient for a conviction. However, it firmly linked the suspect with the crime site and in combination with other evidence was successfully utilized by prosecutors Sharon McLaughlin and Larry Thompson and criminal investigator Dennis Timmons. The suspect, David Noel Saddle mire, was convicted of aggravated kidnapping with the jury taking only 55 minutes to reach their verdict (Fig. 4). He was subsequently sentenced to 99 years in the Texas state prison system.

Ectozoochory, the transport of a diaspore or propagule on the outside of an animal, is a common mechanism of dispersal among flowering plants (van der Pijl 1982). While there are various types of diaspores (e.g., vegetative bulbils, fragments of the parent plant), the most common types are seeds, whole fruits, or fruit segments (e.g., mericarps as in the above example). Various methods of attachment are known, ranging from viscous

FORT WORTH POLICE DEPARTMENT  
CRIME LABORATORY

## RECEIPT

CASE NO. 141868TYPE CASE Kidnapping/Sexual Assault ChildOFFENSE NO. 95 364266VICTIM A. S.SUSPECT David SaddlemireReceived from: Barney Lipscomb Title and Address: Asst. Dir. Ball 509 Pecan St. Ft Worth 76102DATE 7-8-96 TIME 1230 AM PM AT BRIT

## DESCRIPTION:

Received botanical evidence as listed below:

A tape sealed brown paper bag containing:

1. A tape sealed bag holding plant material (11 - Invoice #95 C03400).
2. A tape sealed envelope holding:
  - A. A tape sealed envelope holding plant material collected from right shoe #22 (Invoice #95C03410).
  - B. A tape sealed envelope holding plant material collected from left shoe #23 (Invoice #95C03410).
  - C. A tape sealed envelope holding a subsample of plant material (28 - Invoice #95C03471).
3. A tape sealed bag holding plant material (28 - Invoice #95C03471).

4. A sealed envelope containing paper fold holding bars for photographing.

PRINT Greta Lynn VardySIGNED [Signature]ADDRESS F.W.P.D. Crime LabTELEPHONE NO. 817 877 8084001-35506-025  
8-1-77

FIG. 1. Receipt of botanical evidence from the Fort Worth Police Department Crime Laboratory.

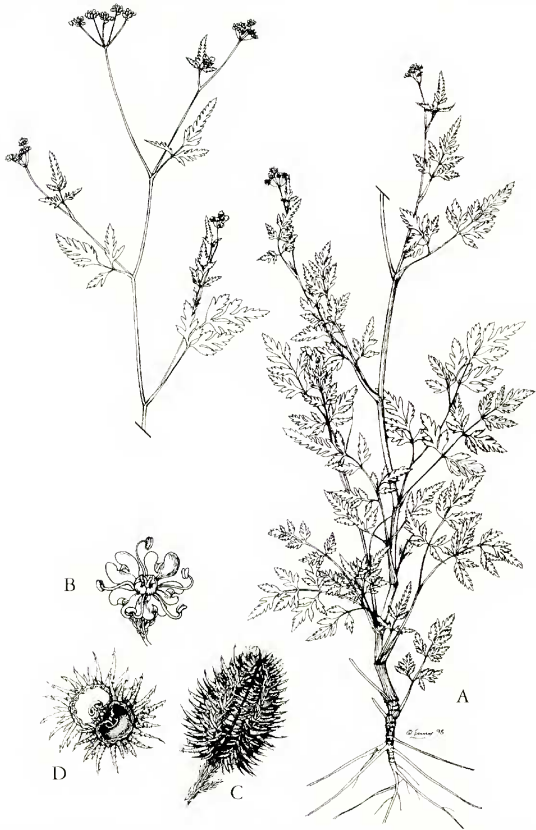


FIG. 2. *Torilis arvensis*. A) habit; B) flower; C) fruit showing mericarps with uncinata bristles; D) cross-section of fruit (drawn by Linny Heagy).

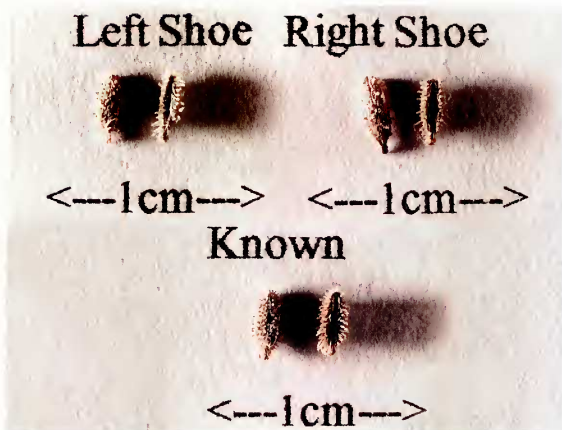


FIG. 3. Photographs of mericarps from both the suspect's shoelaces and the crime scene (Photos by Larry A. Reynolds, courtesy of Tarrant County Medical Examiner).

or mucilaginous substances that cause the propagule to stick to the dispersal agent, to very sharp, barbed or recurved hooks, spines, or awns (van der Pijl 1982). We believe that many of these examples are potentially valuable to law enforcement agencies. From many field trips both for research and with students, it has been our experience that it is rare to return from the field without attached plant material either on the clothes, in pant cuffs, on socks, or embedded in shoelaces. Some of these are merely annoying, while others (e.g., *Aristida* species—threeawn grasses) are extremely irritating when penetrating socks or pants. Many of these seeds or fruits frequently get transferred to the interior of cars on carpeting or upholstery. One does not have to go far from the sidewalk to encounter such plant materials. Because many abundant weedy species are animal-dispersed, yards, abandoned lots, and virtually any weedy or disturbed site will have some such species. Because these plant materials are so frequently encountered and because different plant species are found predominantly in specific habitats and during particular seasons, they are potentially valuable sources of evidence that can link suspects with crime scenes both spatially and temporally. Also, many (e.g., tiny fruit segments of some Apiaceae or tiny fruits of some grasses)

**TARRANT COUNTY**OFFICE OF THE  
CRIMINAL DISTRICT ATTORNEYTIM CURRY  
CRIMINAL DISTRICT ATTORNEY  
817/884-1400JUSTICE CENTER  
401 W. BELKNAP  
FORT WORTH, TX 76104-0281

April 21, 1997

Mr. Barney Lipscomb  
Botanical Research Institute of Texas  
509 Pecan Street  
Fort Worth, Texas 76102

Dear Mr. Lipscomb:

Thank you for your expertise and assistance in the David Saddlemire trial. The case was a complex one and your testimony was very helpful in explaining to the jury one of the circumstances surrounding the offense.

The defendant was found guilty and sentenced to 99 years in the penitentiary. Again, thank you for your assistance. This case was an important one to the State of Texas and this community.

Sincerely,

Sharon McLauchlin  
Assistant Criminal District Attorney

FIG. 4. Letter from Tarrant County Office of the Criminal District Attorney confirming the jury conviction of David Noel Saddlemire.

become deeply imbedded in cloth or carpeting, go virtually unnoticed, and often remain attached even after repeated washings or other types of cleaning. Further, seeds and fruits are easily and inexpensively identified by trained botanists using nothing more than a 10X hand lens or inexpensive dissecting scope, taxonomic literature, appropriate illustrations, and herbarium specimens. While molecular forensic techniques can potentially provide very definitive information, they are much more expensive, require sophisticated laboratory facilities, and are less intuitively obvious for courtroom presentation.



Sometimes the attachment of ectozoochorous propagules can be quite tenacious. This means that they could be attached to a perpetrator's clothing for a very long time, or even enter the flesh. The following are specific examples from mammals that illustrate the point. Sharp-pointed structures such as fruits or awns can penetrate the mouth or other tissues of livestock (and have to be extracted by pliers) or even become subcutaneous and require surgical removal. Veterinarians (John Brakebill, Larry Edwards, Ken Lawrence, pers. comm.) indicate that it is not uncommon to find grassburs (*Cenchrus* species), awns (e.g., from *Hordeum* species—foxtail) or the pointed fruits of needle, spear, or threeawn grasses (*Nassella* or *Aristida* species) in animals. For example, in North Central Texas, *Cenchrus* burs are often found embedded between the toes of dogs and grass fruits are known to penetrate buccal tissues including the tongue causing serious problems (Ken Lawrence, pers. comm.). Perhaps more striking is the ability of the sharp fruits of needle grass (apparently, *Nassella leucotricha* (Trin. & Rupr.) Barkworth [formerly known as *Stipa leucotricha* Trin. & Rupr.]—commonly called winter grass, Texas winter grass, spear grass, or Texas needle grass) to deeply penetrate flesh. These can become subcutaneous and require surgical removal; for example, they can enter between the toes of dogs and sometimes migrate long distances subcutaneously causing draining tracts that will not heal until the fruit is removed (Larry Edwards, pers. comm.). The most extreme case we are aware of involved a fruit that penetrated through the skin and then the chest wall of a dog, eventually becoming embedded in a lung and causing a fatal case of pneumonia (John Brakebill, pers. comm.). Also tenacious are the spiny fruits of *Tribulus terrestris* L., puncture vine, of the Zygophyllaceae. These are very painful to both animal and human feet, damage even tires, and are occasionally fatal to livestock if eaten (Correll & Johnston 1970); it would not be surprising to find them attached to various objects and possibly even the tires of a suspect's vehicle.

Locally in North Central Texas, we believe *Soliva pterosperma* (Juss.) Less., lawn burweed, (Asteraceae) collected from a soccer field near Arlington, Tarrant Co. (1995), was possibly spread from eastern Texas by athletic shoes; its fruit is easily, and painfully, attached by its persistent, spine-like style (Diggs et al., forthcoming). Such propagules could remain attached to a suspect's clothing or shoes for long periods of time. Other Asteraceae are well-known as being animal-dispersed with the pappus of many species being modified into an attachment structure. The retrorsely barbed awns of *Bidens* species, beggar's ticks, are strikingly effective. In another composite genus, *Xanthium*, cocklebur, the surface of the bur is conspicuously covered with stiff, hooked prickles ca. 5 mm long and the bur is also terminated by two prominent spines. The attachment of the hooked prickles to clothing or shoelaces is

very effective and they can also easily penetrate human skin. The hooks are strikingly reminiscent of velcro. According to the VELCRO® Industries homepage ([www.velcro.com](http://www.velcro.com)), in the early 1940s, a Swiss inventor, George de Mestral, after a walk noticed "cockleburrs" [presumably *Xanthium*] on his dog and his pants. He examined the hooked prickles under a microscope and derived the idea for the well known two-sided fastener—one side with stiff, cocklebur-like "hooks" and the other side with soft "loops" like the cloth of his pants. The word velcro comes from the French words *velours*, velvet, and *croché*, hooked.

While some of the examples above were presented to show the tenacity with which diaspores attach, commonly the seeds or fruits are small and merely cling to the fur, feathers, feet, beak, etc. of the dispersal agent with little or no adverse effect. Because they are often small and inconspicuous, they may be particularly valuable from the forensic standpoint. A well known such member of the Fabaceae (legume family) is the genus *Desmodium*, tickseeds. The fruits or loments are jointed and break apart into 1-seeded flat segments that are the dispersal units; they easily attach to hair or clothing. In North Central Texas for example, there are 12 members of this genus, a number of them occupying rather specific habitats (Diggs et al., forthcoming). Other well known examples are the numerous Apiaceae that have small schizocarps (a fruit that splits between carpels into one-seeded portions called mericarps) whose mericarps are covered with bristles or hairs and become readily attached to many surfaces. These are particularly well known to owners of long-haired dogs because large numbers of the mericarps become entangled in the fur—sometimes the situation is so severe that the only recourse is to shave the dog. The final example given here is the legume genus *Medicago*, commonly known as bur-clovers. There are numerous introduced species of this genus, many of which have prickly fruits. These fruits can be somewhat larger than those mentioned previously, but are still effective at attaching to dispersal agents. Numerous other examples could be given which have potential use forensically. Fortunately, most are easily identified by experienced field botanists because such researchers have encountered them many times on their own clothing or equipment.

Other less obvious diaspores could also be potentially useful. For example, at the present time, several invasive aquatic species (e.g., *Hydrilla verticillata* (L.f.) Royle, in the Hydrocharitaceae) are spreading in North Central Texas, apparently by power boats transporting vegetative propagules (plant fragments). In areas of the country where there are numerous relatively new reservoirs and where the distributions of many aquatics, especially introduced species, are spotty, plant material of a given species could easily be used in linking a suspect with a given body of water.

## SUMMARY

Forensic botany is a developing discipline that potentially has broader applicability than is seen at present. Technically simple, visually obvious, easily understood, and inexpensive methods such as the use of animal-dispersed seeds and fruits are particularly worthy of further consideration. Because of the inherent interest in criminal cases, the potential for emphasizing problem solving and critical thinking skills, and the integrative nature of the subject, forensic botany is a field that can be useful in botany and biology education.

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