International Journal of Forensic Expert Alliance
https://doi.org/10.70818/ijfea.v01i01.07
Vol. 1, No. 1, 2024

ISSN (Print): 3078-6673
ISSN (Online): 3078-6681

ARTICLE | OPEN ACCESS

Forensic Botany: The Growing Discipline Revolutionizing Plant Science and Criminal Investigations

Md Kafil Uddin*[1], Sabiha Yasmin Moni[2], Md Shamsul Islam[3], Md Mizanur Rahman[4], Nasima Sultana[5], Md Rakibul Islam[6]

[1] Associate Professor, Department of Forensic Medicine & Toxicology, Rajshahi Medical College, Rajshahi, Bangladesh. [2] Professor, Department of Pharmacology & Therapeutics, Rajshahi Medical College, Rajshahi, Bangladesh. [3] Associate Professor, Department of Forensic Medicine & Toxicology, Sylhet MAG Osmani Medical College, Sylhet, Bangladesh. [4] Associate Professor, Department of Forensic Medicine & Toxicology, Shaheed Ziaur Rahman Medical College, Bogura, Bangladesh. [5] Lecturer, Department of Forensic Medicine & Toxicology, North Bengal Medical College, Sirajganj, Bangladesh. [6] Lecturer, Department of Forensic Medicine & Toxicology, Barind Medical College, Rajshahi, Bangladesh.

ABSTRACT: ***Background:*** Forensic botany is the study of plants in legal cases. It's a fast-growing field. Changing criminal investigations and plant research. Forensic botanists analyze plant parts. These include seeds, pollen, leaves, and wood. They give vital evidence. It can establish timelines, connect suspects to murder scenes, and locate secret graves. This field is multidisciplinary. It offers new tools for crime investigation. It fuses botanical knowledge with modern forensic procedures. Forensic botany's advancement has a big impact. It affects our understanding of nature and the law. ***Aim and objectives:*** This study aimed to observe the forensic botany growing discipline revolutionizing plant science and criminal investigations. ***Materials:*** This Observational Study outline offers a thorough method for forensic botany, facilitating accurate identification of plants and making a major contribution to criminal investigations. The all-encompassing method highlights the interdisciplinary nature of this developing discipline by fusing cutting-edge molecular and chemical investigations with conventional botanical procedures. ***Results:*** This article gives information about various disciplines. Sub-discipliners of forensic botany. The various disciplines in forensic botany. Proper sequence for forensic evidence: First and foremost, evidence must be recognized at the crime scene. Secondly, but no less importantly, it's essential that evidence must be well documented. Finally, collection and preservation must be maintained so on preserve the integrity of the evidence. Investigators are trying to establish linkages or associations between the victim, suspect, scene, and individual items as with any form of evidence. Overall, the study confirms that forensic botany is a powerful tool in criminal investigations. It provides a scientific basis for linking suspects to crime scenes, reconstructing events, and uncovering vital evidence. ***Conclusion:*** The study's results highlight a potential link. It's between forensic botany and criminal investigations. Forensic botany is the use of plant evidence to aid in forensic death investigation. Plants can give useful information. By analyzing plant evidence, forensic investigators can find key information. It can help solve cases and catch criminals.

Keywords: Forensic Botany, Criminal Investigation, Plant Science, Revolutionizing.

Check for updates

***Correspondence:**
Dr. Md. Kafil Uddin

How to cite this article:
Uddin MK, Moni SY, Islam MS, Rahman MM, Sultana N, Islam MR; Forensic Botany: The Growing Discipline Revolutionizing Plant Science and Criminal Investigations. *Int. J. Forensic Expert Alliance*. 2024; 1 (1): 46-52

Article history:
Received: March 04, 2024
Revised: March 30, 2024
Accepted: May 25, 2024
Published: June 27, 2024

Peer Review Process:
The Journal abides by a double-blind peer review process such that the journal does not disclose the identity of the reviewer(s) to the author(s) and does not disclose the identity of the author(s) to the reviewer(s).

Copyright: © 2024 by the author(s). This is an open-access article distributed under the terms of the **Creative Commons Attribution 4.0 International License (CC BY-NC 4.0)** which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited.

INTRODUCTION

The law of circumstances states that "Facts do not lie, but man can do." This law proves that every piece of evidence is important and useful while investigating a sequence of events. It also indicates that oral testimony can be influenced or changed, but the result of physical applies the knowledge, techniques, and study of plant science to legal matters.[1] The importance of forensic botany lies in its ability to provide unique evidence that can corroborate or refute other findings in a criminal investigation. For instance, the specific identification of plant species at a crime scene can link a suspect to the location or track the movement of objects and bodies. Techniques such as palynology (the study of pollen) can reveal whether a body has been moved or

how long it has been in a particular location. Moreover, discipline extends to various subfields, including dendrochronology (the study of tree rings), which can determine the age of wooden objects and trace their geographic origin.[2] One of the most compelling aspects of forensic botany is its application in historical and high-profile criminal cases. For example, botanical evidence has played a crucial role in solving cases such as the Lindbergh kidnapping in the 1930s, where wood analysis helped trace the ladder used by the kidnapper. More recently, forensic botany has been instrumental in uncovering clandestine graves in war-torn regions and in tracking illegal logging activities, demonstrating its broad relevance and impact.[3]

Botanical trace evidence can be used for different purposes, such as establishing links between suspects, victims, crime scenes, and objects. This link was established by comparing those botanical pieces of evidence obtained from suspects with botanical evidence found at the crime scene.[4] However, using forensic botany is limited in criminal or civil cases because a diminutive number of forensic scientists are trained for this field through academic learning.[5] Also, although most forensic scientists are familiar with methods for human identity testing, the evidence from plants, animals, and insects remains unknown. This scarcity in knowledge is due to the lack of awareness by evidence collection teams, who are unaware of the value of collecting botanical trace evidence.[6] The scope of forensic botany extends beyond criminal cases. Environmental forensics, a related branch, uses similar techniques to investigate ecological crimes such as illegal logging, habitat destruction, and pollution. This overlap underscores the versatility of botanical evidence in addressing a wide array of legal and environmental issues. For example, the analysis of tree rings and growth patterns can not only help determine the timeline of a crime but also monitor environmental changes and compliance with conservation laws.[3] As the field advances, it continues to integrate cutting-edge technologies such as DNA barcoding and geographic information systems (GIS), enhancing the precision and scope of botanical evidence. DNA barcoding allows for the identification of plant species from minute samples, increasing the reliability of botanical evidence.

GIS technology helps in mapping and analyzing spatial data, which can be crucial in cases involving the movement of objects or bodies over large areas.[7] This integration not only improves the reliability of forensic investigations but also underscores the interdisciplinary nature of forensic botany, which draws on expertise from ecology, biology, and environmental science. Forensic botany is a growing field with a substantial body of research supporting its development. Studies such as those by.[8, 9] have expanded our understanding of how plant evidence can be collected and analyzed in various forensic contexts. Additionally, works by.[10] have provided foundational methodologies for the analysis of pollen in forensic investigations, while research by.[11] has highlighted the role of plant DNA in linking suspects to crime scenes. In conclusion, forensic botany is a dynamic and evolving discipline that is revolutionizing both plant science and criminal investigations. Its ability to provide unique and critical evidence underscores the profound connection between the natural world and human activities. As forensic botanists continue to refine their techniques and expand their applications, the field promises to play an increasingly vital role in the pursuit of justice and the advancement of scientific knowledge. [2, 3]

Objectives

General Objective

To observe the forensic botany growing discipline revolutionizing plant science and criminal investigations.

Specific Objectives

To know the role of forensic botany in crime scene investigation and its current trends.

Using plant evidence to support forensic death investigations.

METHODOLOGY

This Observational Study outline offers a thorough method for forensic botany, facilitating accurate identification of plants and making a major contribution to criminal investigations. The all-encompassing method highlights the interdisciplinary nature of this developing discipline by fusing cutting-edge molecular and chemical investigations with conventional botanical procedures. This study was conducted at Rajshahi Medical College's Department of Forensic Medicine &

Toxicology in Rajshahi, Bangladesh. It took place from January 1st, 2024, until May 31st, 2024. The authors' attempt to cover several forensic botany subdisciplines with appropriate illustrations is presented in this study.

RESULTS

Disciplines of Forensic Botany: Different sub-disciplines exist, which come under forensic botany. They include palynology (the study of pollen and spores), plant anatomy, which includes leaf morphology (the study of leaf), dendrochronology (the study of growth rings of tree stems, wood, and roots), bryology (the study of bryophytes), plant ecology (the study of the growth pattern of vegetations), limnology (the study of freshwater plants), and plant systematics (the study of evolutionary relationships between plant species and taxonomy for the analysis of plant species).[12] The details presented have forensic significance.[13] This article also gives information about various disciplines. Sub-disciplines of forensic botany and various disciplines in forensic botany.

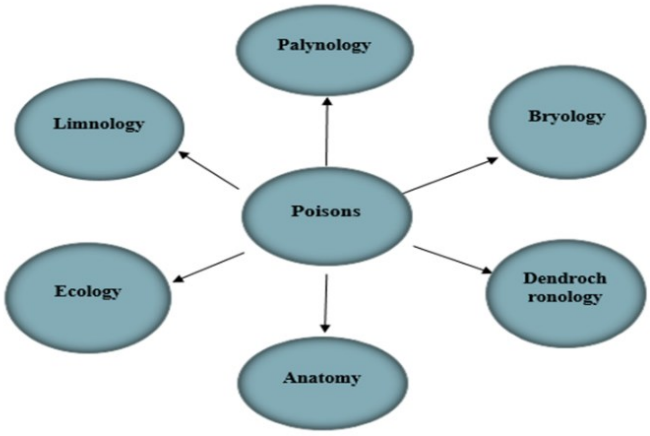

Figure 1: Disciplines of Forensic Botany

Proper sequence for forensic evidence: First and foremost, evidence must be recognized at the crime scene. Secondly, but no less importantly, it's essential that evidence must be well documented. Finally, collection and preservation must be maintained so on preserve the integrity of the evidence.

Figure 2: A Schematic Diagram of the Proper Sequence for Forensic Evidence.

Which plant evidence was properly utilized is attributed to the general methodology of crime scene investigation? Investigators are trying to establish linkages or associations between the victim, suspect, scene, and individual items as with any form of evidence (Figure 2, Figure 3).

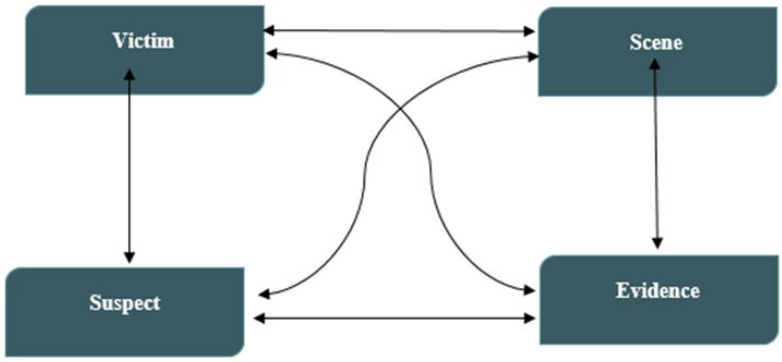

Figure 3: Botanical Evidence May be Used to Link Suspects, Victims, and Crime Scenes Using Four-way Linkage Theory

Botanical evidence is crucial in understanding the natural world and the relationships between different plant species. This evidence can include plant morphology, anatomical features, biochemistry, and molecular genetics. For example, the shape and structure of a plant's leaves, flowers, and seeds can provide clues about its evolutionary history and ecological niche.[14]

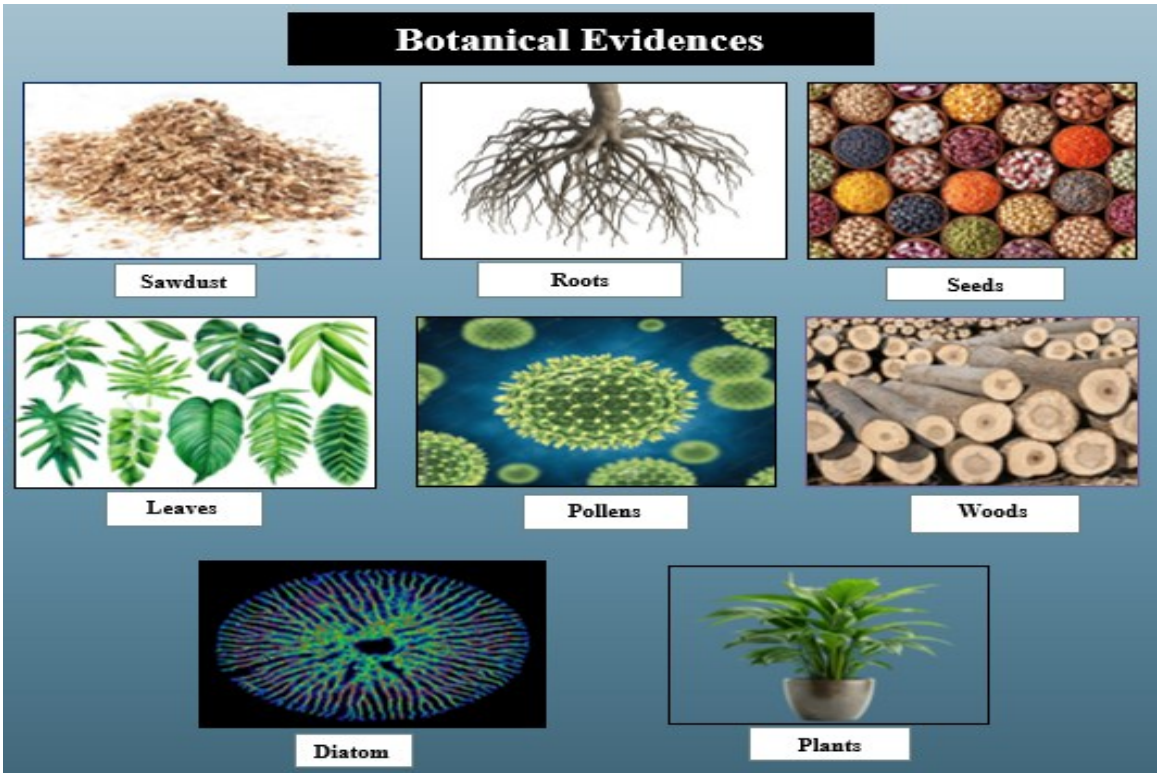

Figure 4: Utilizing Plant Samples in Forensic Botanical Evidence.

Plant poisons are the chemical constituents of organic nature, which are naturally synthesized in the plants through their individual cellular activities with the help of enzymes. Based on their effect on the body, the plant-based poisons are broadly classified in three major groups such as (Systemic, Corrosive and Irritant). Which are sub-divided according to their chemical composition and site of action that are summarized in Figure 2.[24-26]

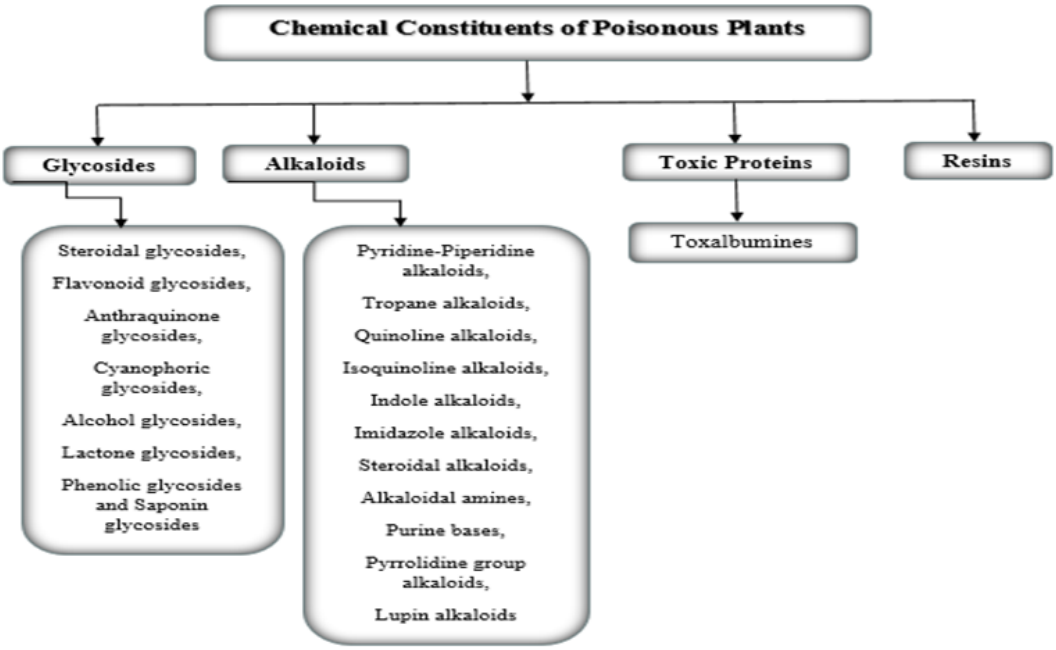

Figure 5: Classification Of Poisonous Plants on the Basis of Chemical Constituents.

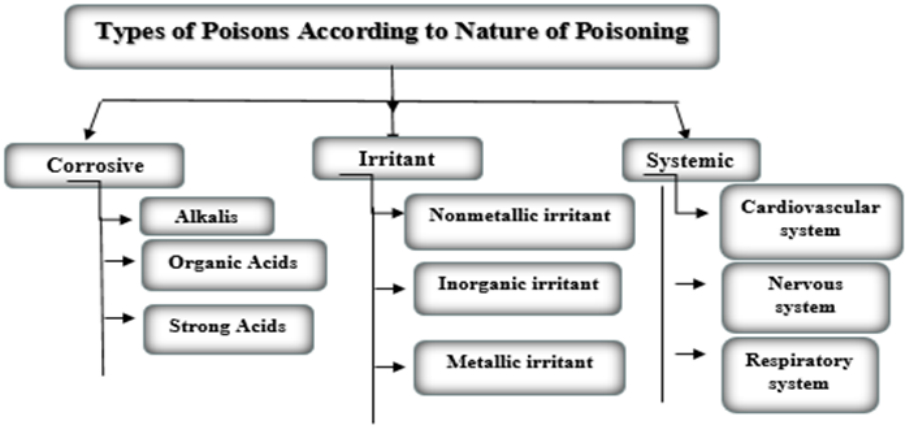

Figure 6: Types of Poisons According to Nature of Poisoning

DISCUSSION

An effective tool for investigating crime scenes is forensic botany. Botanical materials have the potential to link a suspect to a crime scene or identify the cause of death, be it homicide, suicide, or accident.[15] A tiny fragment of plant could provide crucial information to the court. Pollen samples, for instance, can be helpful in differentiating one year from another.[16] Additionally, the growth rate of certain moss species can be a reliable indicator of the lowest PMI.[16] However, no search for that evidence will take place until an investigator is aware that it might exist. It is important to note that botanical evidence can be found at the microscopic level at crime scenes (e.g., pollen grains) and that meticulous gathering, recording, and storage of botanical evidence is essential to the assessment of plant evidence.[15] Sadly, inexperienced workers have frequently collected samples.[17] Regulations should specify that the collection of plant materials must include control samples. Simple microscopy or more advanced plant DNA testing can be used to study plant material.[18] In forensic botany, the plant species must first be recognized using morphological traits, microscopy, or molecular biology.[19, 20] Once the species has been determined, an effort is made to individualize the sample. Source attribution may not be difficult if a plant is scarce in the sampling area;

nonetheless, the effectiveness of source attribution will rely on how rare the species is in the geographic area.[21] Every criminal case should consider forensic botany, particularly (though not just when the crime occurs in an open space).[22] The botanical evidence is circumstantial and weak on its own, but when combined with the other discoveries, it can give the courts sufficient direct and circumstantial evidence.[23] Even though it is now obvious that forensic botany can play a significant part in many forensic investigations, it is still not widely acknowledged in many countries.[15]

There are several kinds of botanical evidence at the crime site. For instance, a poison is described as a material that has the potential to negatively impact human health. If a tiny amount of the plant's stem, leaves, seeds, fruits, or roots are consumed, toxic plants have been used for assassinations, suicides, murders, and executions since ancient times.[24, 25] The intent behind the administration of a substance determines whether it is a poison or a medicine. It is a medicine if the goal is to save lives; if it is administered with the goal to injure, it is a poison.[25] According to Paracelsus (1493-1541), the father of toxicology said "Everything is poison, there is poison in everything, only the dose makes a thing not a poison" Now a days, mostly poisons are used for robbery and suicidal purposes.[26] Suicide is very common as poison can be easily obtained and many poisonous plants grow wild e.g., datura, oleanders, aconite etc. A lot of work has been reported on toxicology of plants, but in this present study, a review has been performed on most of chemical constituents of plants in terms of forensic context.

Limitation of the Study

This study was carried out in an uncommon situation where more data was not accessible, and it was finished rather quickly. As a result, the outcomes might not fairly depict the overall scenario.

CONCLUSION

The study's results highlight a potential link. It's between forensic botany and criminal investigations. Forensic botany is the use of plant evidence to aid in forensic death investigation. Plants can give useful information. They are helpful in cases of missing people, homicides, accidental deaths, and other crimes. Plant evidence can help establish the time and location of death, link suspects to crime scenes, and even determine cause of death. There are several ways in which plant evidence can be used in forensic investigations. In addition to plant evidence, botanists can use growth patterns and seasonal changes. They use these to find the time of death in a forensic investigation. For example, if plant roots grow through a victim's clothing, it can show that the body has been at the crime scene for a long time. Similarly, some plants only bloom during specific seasons. They can help show when a crime takes place. Forensic botany is a valuable tool in criminal investigations. It provides important insights into the circumstances of a death. By analyzing plant evidence, forensic investigators can find key information. It can help solve cases and catch criminals.

REFERENCES

1. Ferri G, Alù M, Corradini B, Beduschi G. Forensic botany: species identification of botanical trace evidence using a multigene barcoding approach. Int J Legal Med 2009; 123(5):395-401. doi: 10.1007/s00414-009-0356-5, PMID 19504263.
2. Coyle, H. (2021). Forensic Botany: Principles and Applications to Criminal Casework. CRC Press.
3. Miller Coyle, H. (2005). Forensic Botany: An Introduction. CRC Press.
4. Graham, S.A. (1997), Anatomy of the Linderberg kidnapping. J Forensic Sci, 42, 368-377.
5. Wesselink M, Kuiper I. Species identification of botanical trace evidence using mol Use the ''Insert Citation" button to add citations to this document. ecular markers. Forensic Sci Int Genet Suppl Ser 2008; 1(1):630-2. doi: 10.1016/j.fsigss.2007.10.211.
6. Margiotta G, Bacaro G, Carnevali E, Severini S, Bacci M, Gabbrielli M. Forensic botany as a useful tool in the crime scene: report of a case. J Forensic Leg Med 2015; 34: 24-8. doi: 10.1016/j.jflm.2015.05.003, PMID 26165654.
7. Coghlan, A. (2012). DNA Barcoding: Nature's Fingerprint. New Scientist.
8. Hall, D.W. (2010). Forensic Botany: An Overview*. Journal of Forensic Sciences, 55(3), 724-735.
9. Murray, C. (2012). Plant Evidence in Criminal Cases: A Comprehensive Guide. Forensic Science Review, 24(2), 123-145.
10. Linskens, H.F., & Jorde, W. (1997). Pollen as Forensic Evidence. Springer.

11. Norris, S. (2007). Forensic Botany: The Role of Plant DNA in Criminal Investigations. Science & Justice, 47(4), 224-230.
12. Phuphumirat W, Iadprapan N, Mildenhall DC. Methods for collecting spore and pollen samples from city pavements and the palynomorph distribution in urban areas. Grana 2020; 60(00):1-16. doi: 10.1080/00173134.2020.1791246.
13. Bryant VM, Mildenhall DC. Forensic palynology: a new way to catch crooks. Vol. 33(July). p. 145-55; 1998. New Dev palynomorph sampling, Extr. Anal. http://anthropologyworldnews.tamu.edu/faculty/bryant/publications/Bryant-Mildenhall-1998-New-Way-to-Catch-Crooks.pdf.
14. Soltis, D. E., Smith, S. A., Cellinese, N., Wurdack, K. J., Tank, D. C., Brockington, S. F., Leebens-Mack, J. (2011). Angiosperm phylogeny: 17 genes, 640 taxa. American Journal of Botany, 98(4), 704-730.
15. Miller Coyle H, Lee CH, Lin WY, Lee HC, Palmbach TM. Forensic botany: using plant evidence to aid in forensic death investigation. Croat Med J 2005;46(4): 606e12
16. Lancia M, Conforti F, Aleffi M, Caccianiga M, Bacci M, Rossi R. The use of leptodyctium riparium (Hedw.) warnst in the estimation of minimum postmortem interval. J Forensic Sci 2013 Jan;58(Suppl. 1): S239e42.
17. Mildenhall DC, Wiltshire PE, Bryant VM. Forensic palynology: why do it and how it works. Forensic Sci Int 2006 Nov 22;163(3):163e72.
18. Miller Coyle H, editor. Forensic botany: principles and applications to criminal casework. Boca Raton (FL): CRC Press; 2005.
19. Hall DW. The contributions of the forensic botanist to crime scene investigations. Prosect 1988; 22:35e8.