Detecting Blood in Soil after Six Years with Luminol

Ron Gabel, Denver Police Department (CO),
Sheri Shimamoto, Lakewood Police Department (CO),
Ivanie Stene, Westminster Police Department (CO),
and Tom Adair

Abstract: In October of 2004 the authors began a study to examine the possibility of detecting blood in soil over extended periods of time. A sample grid was created on a hilltop at the Highlands Ranch Law Enforcement Training Facility located in Douglas County, Colorado (USA). The sample grid is comprised of six 24"x24" (61x61cm) units in which 500ml of neat horse blood was poured in an "X" pattern. Subsequent studies have shown that a recognizable "X" pattern persisted up to 16 months and that blood can be detected at the site up to four years following deposition. This paper presents another extension of that detection up to six years.

Keywords: Luminol, blood detection, bloodstain pattern analysis

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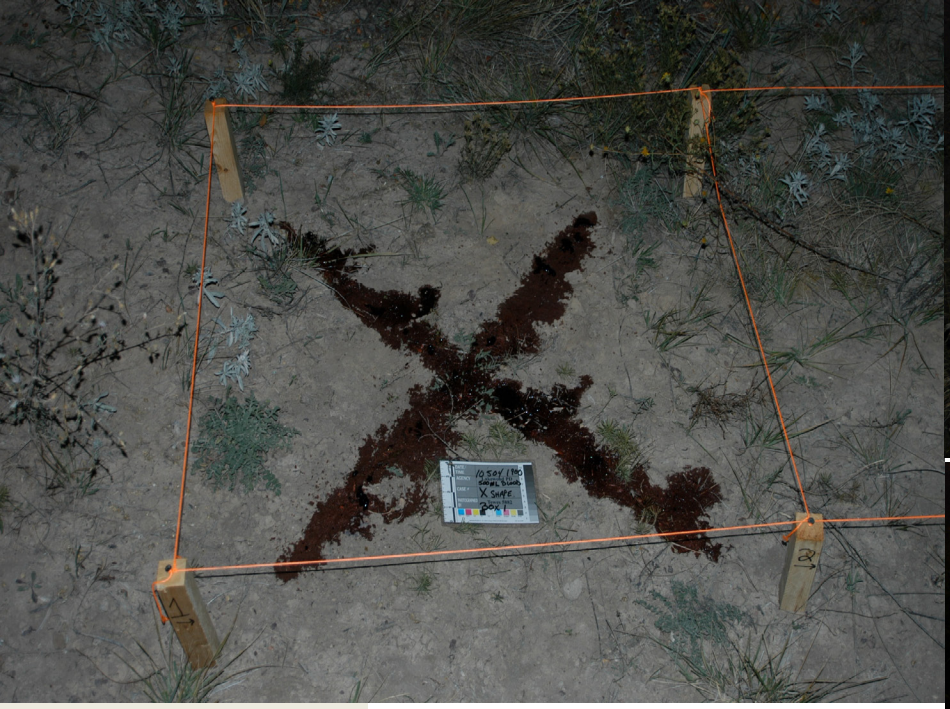
Introduction

In October of 2004 the authors began a study to determine how long trace amounts of blood could be detected in soil using the Luminol reagent. The authors have previously reported on the use of the Luminol reagent to detect blood in soil up to fours years following deposition [1-3]. Since 1937 the Luminol reagent has been used to detect latent bloodstains [4]. Studies have been conducted on the detection of blood at crime scenes after various efforts of clean-up with commercial cleaners and/or water but few have reported on the detection of blood from soil after extended periods of time [5,6]. Noedel and Jagmin experimented in the state of Washington (USA) with commercial fertilizer containing dried blood in soil and were able to detect the blood with Luminol after one year of exposure [7]. Luminol has documented apparent bloodstains in very old indoor crime scenes as well. In a 2004 documentary on the Discovery channel Luminol was used to detect blood on the floor joists below the murder site of Mr. Andrew Borden in the infamous Borden murders of 1892 in Fall Rivers, Massachusetts (USA)[8]. This reaction was 112 years after the murder occurred.

Materials

The research site is located at the Highlands Ranch Law Enforcement Training Facility in Douglas County, Colorado (USA). The study location is on the crest of a fully exposed hilltop within the controlled facility. The elevation of the site is approximately 1830m (6000 ft) above sea level and is comprised of grassy meadows and rolling hills of Gambel Oak (Quercus gambelii) with scattered stands



▲ **Figure 1**

of conifer. Annual precipitation at the site is approximately 16" (41cm). The testing area consists of six 24 square inch (61cm^2) grids aligned in a row. In October 2004 an approximately 500ml "X" pattern of "neat" horse blood was poured in each grid unit (figure 1). Visible blood could not be seen after one week of exposure on the site. The initial study was only designed to last two years wherein each half of the "X" pattern would be tested every two months. The Luminol reagent was mixed on site using the following formula: .5g 5-amino-2,3-dihydro-1,4-phthalazinedione (Luminol), 25g sodium carbonate, 3.5g sodium perborate, per 500ml distilled water. The initial results were impressive and the "X" pattern of blood retained its shape up to 16 months (figures 2-4). Additionally there was no false positive reaction with the surrounding soil. Further testing was conducted out to four years. Over time the reaction area became weaker on the surface. The authors then began scraping away several inches of the topsoil to test the deeper soil levels. Although the "X" pattern was no longer recognizable, the testing area still yielded a strong and immediate reaction to the application of Luminol up to four years (figure 5). No testing of the site was done between October 2008 and September 2010. On the night of October 15, 2010 the authors returned to re-test

Figure 2 (right, top): Luminol reaction at 4 months following deposition. ▶

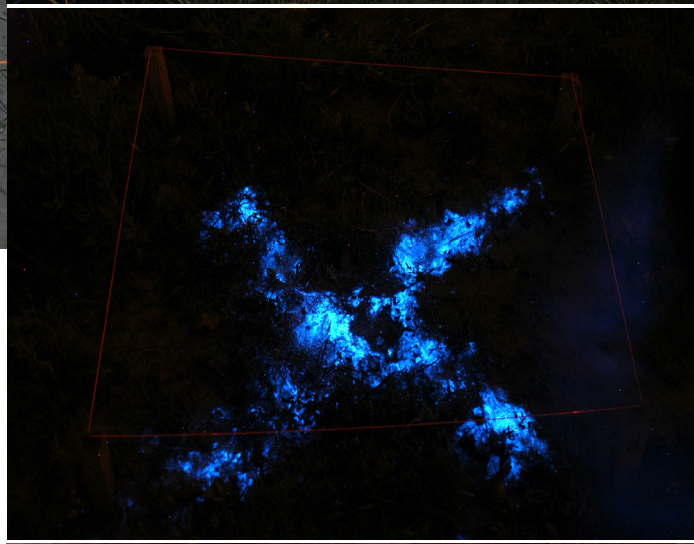


Figure 3 (right, second down): Luminol reaction at 8 months following deposition.

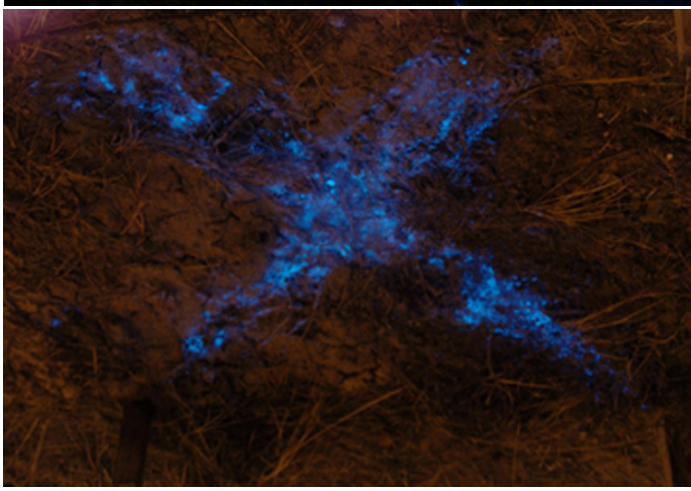


Figure 4 (right, third down): Luminol reaction at 16 months following deposition.

Figure 5 (right, bottom): Luminol reaction at 4 years following deposition.

Figure 6 ◀

two grid units. The skies were clear with a full moon and no breeze. Luminol was applied on two separate grid units (#6 and #3) using a commercial spray bottle and the above mentioned formula. Two digital cameras, a Nikon D80 (28-105mm f/4.0 lens) and Nikon D2H (18-135mm f/3.5 lens), were used to document the reactions. Both cameras were on a bulb setting with exposures between 1-2 minutes for best results.

Results

The grid units were photographed prior to any spraying (figure 6). There was no unusual visible staining or coloration to the soil. Vegetation included sporadic grasses and weeds. Both grids showed very small areas of immediate chemiluminescence following the application of the reagent. As in previous studies the authors scraped approximately 3-4" (8-10cm) of soil from the top of the testing area. The reagent was applied again and a much larger reaction area was developed (figure 7). The fill dirt also reacted to the reagent (figure 8). There was no attempt to excavate deeper testing strata as in the previous study. To test for false positives Luminol was applied to soil outside the testing grids with negative results.

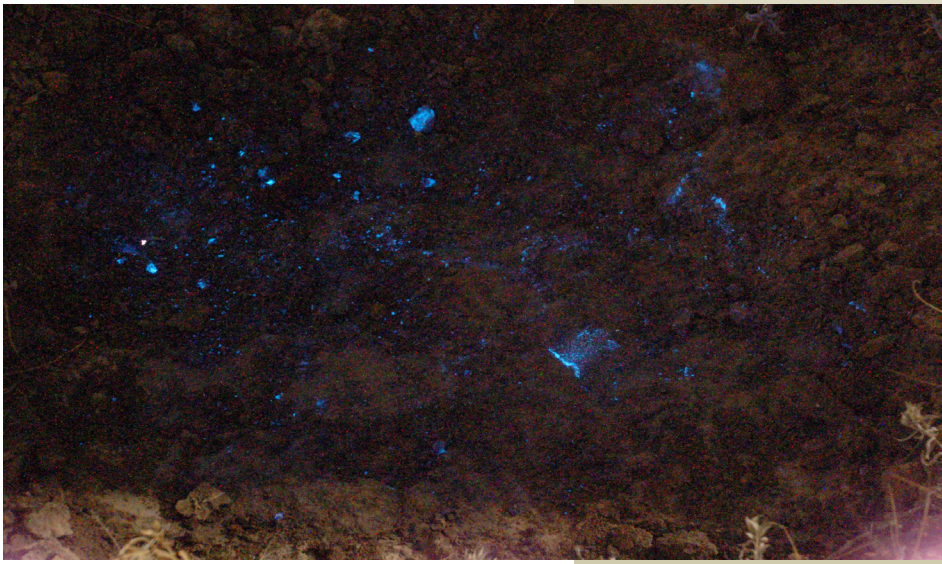
Discussion

This study effectively shows that latent blood can be detected in soil up to six years after deposition. As with the previous examination two years earlier the blood was detectable at a depth of 3" to 4" (8-10cm). This suggests that although the visual blood may disappear rapidly from the soil surface, the detectable blood remains in the top few inches of the soil horizon for extended periods of time. Although DNA could not be extracted from such a site, the ability to detect latent blood in soil has some practical advantages to the crime scene reconstructionist. First, finding such a site may be useful in corroborating statements made by suspects or witnesses as they pertain to the location of blood letting events. Second, discovering an area

Figure 7 ▼

of bloodletting may facilitate the search for, and recovery of, additional evidence such as expended bullets, cartridge cases, clandestine grave sites, and others. During the first year following blood deposition,

Figure 8 ▼



certain patterns such as drag marks, pooling, or patterned voids may also be detected giving valuable information to the analyst. The cost and application process of Luminol makes it impractical to use over very large search areas. In the absence of a living witness investigators may consider the use of a properly trained (and breed) cadaver dog to locate potential sites of interest.

The authors hope that similar experiments will be conducted in other regions to test the applicability of this reagent under various conditions. We also encourage interested analysts to revisit old outdoor crime scenes with Luminol. Ideally, such crimes scenes will have been well documented so that any reaction can be compared to visible blood documented at the time of discovery. Reports of such experiments will undoubtedly add to our knowledge of this process and may provide other methods of application on various terrain or ground cover.

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