Science and Justice 56 (2016) 269–277

Contents lists available at ScienceDirect

Science and Justice

journal homepage: www.elsevier.com/locate/scijus

Review

Demining Dogs in Colombia – A Review of Operational Challenges, Chemical Perspectives, and Practical Implications

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ARTICLE INFO

Article history:
Received 15 October 2015
Received in revised form 23 March 2016
Accepted 24 March 2016

Keywords:
Demining
Colombia
Antipersonnel mines
Mine detection dogs
Landmine odor signatures

ABSTRACT

Within the framework of an internal armed conflict in Colombia, the use of antipersonnel mines by revolutionary armed forces represents a strategic factor for these groups. Antipersonnel mines are used by these revolutionary forces as a mean to hinder the advancement of the national armed forces in the recovery of territory and to protect tactical natural resources and illegal economies within a given area. These antipersonnel mines and improvised explosive devices (IEDs) are not of industrial manufacturing, and have a variety of activating mechanisms as well as non-metal materials which make them difficult for successful detection. The Colombian experience strongly represents the current need for advanced research and development of effective field operations within its affected territory. Current efforts are focused on a more operational demining perspective in coca cultivation sites in charge of mobile squadrons of eradication (EMCAR) from the National Police of Colombia working towards a future humanitarian demining upon an eventual peace process. The objectives of this review are not only to highlight already existing mine detection methods, but present a special emphasis on the role of mine detection canine teams in the context of this humanitarian issue in Colombia. This review seeks to bring together a description of chemical interactions of the environment with respect to landmine odor signatures, as well as mine detection dog operational perspectives for this specific detection task. The aim is to highlight that given the limited knowledge on the subject, there is a research gap that needs to be attended in order to efficiently establish optimal operating conditions for the reliable performance of mine detection dogs in Colombian demining field applications.

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http://dx.doi.org/10.1016/j.scijus.2016.03.002
1355-0306/

1. Introduction

1.1. Colombia's problem with antipersonnel landmines

Colombia's problem with antipersonnel mines and explosive remnants of war (ERW) is the direct result of over half a century of an internal armed conflict. According to the Colombian government's antipersonnel mine action program, the period ranging from 1990 thru June 9, 2015 registered a total of 11,133 victims due to antipersonnel mines and unexploded ordnance (UXO). From these, 38% were civilians and 62% members of the Armed Forces. Just in the first trimester of 2015, there were a total of 73 victims. The extent of this landmine contamination issue lies in 31 of the 32 departments within the country. The five most affected departments include: Antioquia, Meta, Caquetá, Nariño, and Norte de Santander [1]. Numerous survey and/or clearance tactical operations have shown that this man-made contamination is largely due to improvised explosive devices (IEDs) which act like an antipersonnel mine. Colombia's largest rebel group, the FARC, are believed to be directly responsible for laying many of the mines and other IEDs in Colombian territory. Furthermore, the National Liberation Army (ELN) even though not part of the current peace dialogues, continues to plant new antipersonnel mines in the department of Antioquia, among others. Since 2000, the FARC has increased their implementation as part of their response to the internal conflict across the country, thus making Colombia the only Latin American country to have a rising contamination issue over the past decade [2]. These illegal armed groups tactically use antipersonnel mines and explosive remnants as a way to deny millions of civilians and government authorities the access to land and natural resources that otherwise would increase the country's welfare. Furthermore, the use of landmines represent a cheap way to prevent government authorities' access to illegal economies such as coca plantations, drug transport routes, clandestine laboratories, and guerrilla camps. The use of antipersonnel mines in strategic locations also serves as a terrorist mechanism that restricts and ultimately displaces local communities who are forced to abandon their lands, indigenous and Afro-Colombian communities being the most affected [3].

In view of this problematic, Colombian military forces in coordination with the Presidential Program for Integrated Action against Antipersonnel Mines currently coordinate the operational activities with regards to humanitarian demining in affected territories. Currently, the National Police of Colombia has also joined forces and has implemented different mechanisms to help with the operational demining activities. Typically, the operational planning of humanitarian demining imparts two phases, technical and non-technical. The technical phase is conducted directly on the field with direct physical intervention and technical equipment for humanitarian demining. The non-technical phase studies entail the collection of data and information analysis in regards to suspected areas of mine contamination to identify the types and dimensions of danger perimeters without any physical intervention [4].

1.2. Description and design of antipersonnel mines

The use of antipersonnel mines dates back to World War II as a means to hinder opposing soldiers from clearing antitank mines. These original designs were made from hand grenades and simple electric fuses. Modern designs have greatly developed since then and can now deliver fatal blasts of lethal pellets which can reach a radius of up to 100 m [5]. The basic components of a landmine include the activation/triggering mechanism, the detonator (sets off booster charge), the booster charge (can be attached to fuse, detonator, or be part of main charge), the main explosive charge (bulk body of mine) and the casing that contains all of these components (see Fig. 1) [6].

Illegal armed groups in Colombia manufacture their own landmines with various activation mechanisms that are triggered by the victims themselves. These explosive devices are carefully dug underground in separate locations approximately 5 meters apart and connected by electrical wiring that are not easily detected by traditional mine detection gear. The triggering mechanisms utilized in Colombian territory include syringes, tripwires, clothes-pin, mouse traps, wedges, and remote controls. Furthermore, common explosives used in their manufacture are ammonium nitrate, mixtures of ammonium nitrate with fuel oils (ANFO), mixtures of sawdust with ALANFO (R1), hydrogels, nitroglycerin, trinitroluene (TNT), to name a few [7]. Colombian landmine incidents are further complicated by the inclusion of elements such as feces, nails, glass, and plastic scrap which cause wound infection not readily detected upon medical inspection (Fig. 2). The mine casing themselves are hard to detect as they come in various shapes and sizes of plastic materials (PVC pipes, bottles), textiles, glass, or even wooden boxes. The problem also lies in the amount of explosive material Colombian rebel groups employ. Conventional mines contain from 30 to 520 g of explosive material, while landmines in Colombian territory report 250 g – 4 kg and some have yielded more than 20 kg of explosive content [8].

Landmines can be generally classified as either blast or fragmentation. Blast mines are characterized by a shallow burial, and whose trigger mechanism originates from the pressure coming from a victim as the subject steps on the mine. The activation weight for a typical blast mine ranges from 5–24 lb, making children the most susceptible victims. The activation of a buried landmine causes the affected object (typically victims' lower extremity) to blast into fragments in an upward direction, which is most of the cases the major cause of personal

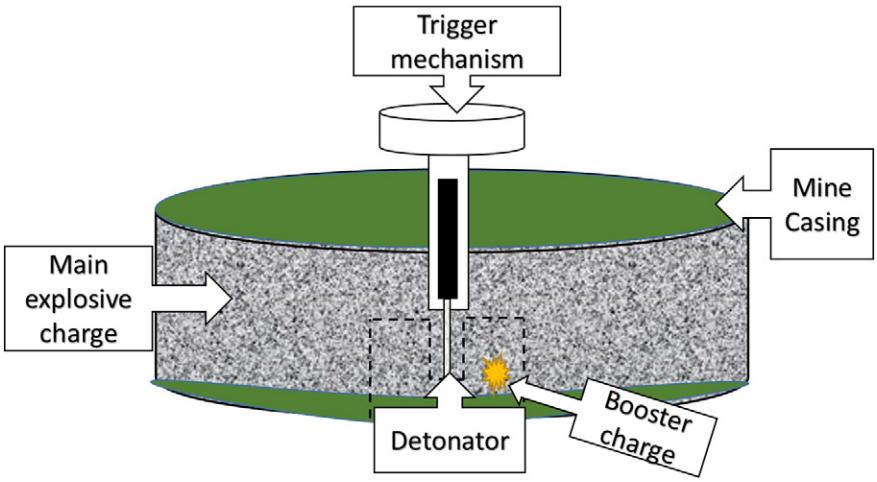

Fig. 1. Schematic of landmine componentry